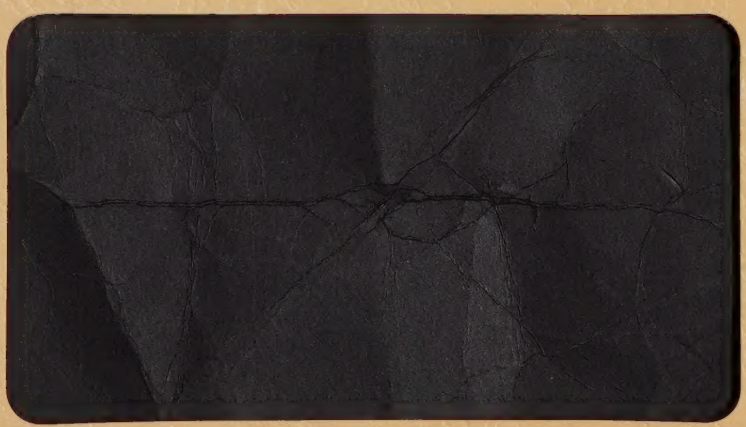
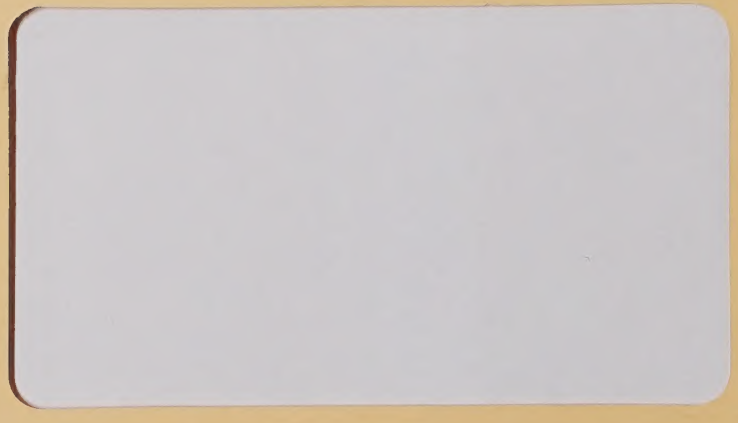
General Radio

INSTRUCTION MANUAL





Contents

SPECIFICATIONS
INTRODUCTION – SECTION 1
INSTALLATION – SECTION 2
OPERATION – SECTION 3
THEORY – SECTION 4
SERVICE AND MAINTENANCE – SECTION 5
PARTS LISTS AND DIAGRAMS – SECTION 6

WARRANTY

We warrant that this product is free from defects in material and workmanship and, properly used, will perform in full accordance with applicable specifications. If, within a period of ten years after original shipment, it is found, after examination by us or our authorized representative, not to meet this standard, it will be repaired or, at our option, replaced as follows:

- No charge for parts, labor or transportation during the first three months after original shipment;
- No charge for parts or labor during the fourth through the twelfth month after original shipment for a product returned to a GR service facility;
- No charge for parts during the second year after original shipment for a product returned to a GR service facility;
- During the third through the tenth year after original shipment, and as long thereafter as parts are available, we will maintain our repair capability and it will be available at our then prevailing schedule of charges for a product returned to a GR service facility.

This warranty shall not apply to any product or part thereof which has been subject to accident, negligence, alteration, abuse or misuse; nor to any parts or components that have given normal service. This warranty is expressly in lieu of and excludes all other warranties expressed or implied, including the warranties of merchantability and fitness for a particular purpose, and all other obligations or liabilities on our part, including liability for consequential damages resulting from product failure or other causes. No person, firm or corporation is authorized to assume for us any other liability in connection with the sale of any product.

Type 1061
Frequency Synthesizer

A

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Concord, Massachusetts, U.S.A. 01742
Form 1061-0100-A
August, 1973
ID-0100-A

Specifications

Fixed Frequency: 400 kHz to 160 MHz in 10-kHz steps with 100-Hz search-sweep settability. Finer steps optional, the finest being 0.1-Hz steps with 0.001-Hz search-sweep settability. LOCAL CONTROL (Option 1): Set by in-line-readout panel switches or external remote-control signals; control transferred by single panel control. REMOTE CONTROL: Set by 8-4-2-1 external signals; logic "1" is 0 to 0.5 V at 3 mA, logic "0" is +5 V at 0 mA. Programming time < 100 μs per step except with economy resolution options (4F or 4G), where it is ≈ 5 ms for steps below 10 kHz.

FREQUENCY OFFSET VS TIME

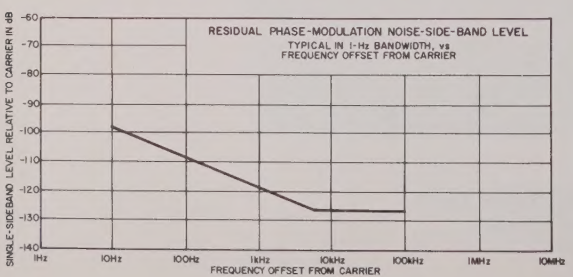
	Digit Switched				
Time	10 MHz	1 MHz	100 kHz	10 kHz and less	Economy 1 kHz
100 μs	<100 Hz	< 10 Hz	< 1 Hz	<0.1 Hz	N/A
1 ms	< 0.1 Hz	<0.1 Hz	<0.1 Hz	<0.1 Hz	<600 Hz
5 ms	< 0.1 Hz	<0.1 Hz	<0.1 Hz	<0.1 Hz	< 10 Hz
10 ms	< 0.1 Hz	<0.1 Hz	<0.1 Hz	<0.1 Hz	< 0.1 Hz

Search-sweep and Frequency Modulation – (limited with economy resolution options 4F and 4G): SWEEP WIDTH: Up to 11 MHz. Any decade, with 1-MHz steps or less, can be replaced by a continuous control with a range of –1 to +10 X one step of the decade being replaced, with a settability of 1/100 of one step. LOCAL CONTROL (Optional): Digit to be replaced is chosen by panel pushbuttons or external signal; frequency is set by –1 to +10 multiplier plus continuous vernier or by external signal. REMOTE CONTROL: Digit to be replaced is chosen by logic signal; frequency is set by +0.5 V/step (–0.5 to +5.0 V) dc signal with nonlinearity of ±0.3 step max. SWEEP (FM) RATE: Dc to 20 kHz, –3 dB. DEVIATION pk-pk: Same as sweep width. HARMONIC DISTORTION: < 6% for all deviations within range of decade selected; < 3% to 5 kHz. STABILITY: $\pm 2X10^{-4}$ step/s, $\pm 1X10^{-3}$ step/min, $\pm 1X10^{-2}$ step/h. AMPLITUDE MODULATION: Dc to 1 kHz at 90% modulation, dc to 10 kHz at 15% modulation; with 5% distortion. Control via remote-control of signal output (see below), achieved by externally summing an a-m rate source with a dc voltage.

Signal Output: 224 mV to 2.24 V rms (0 to +20 dBm into 50 Ω) from 50-Ω source, available at rear GR874® connector (optionally on front panel). LOCAL CONTROL (optional): Set by panel control with ±1.5-dB accuracy or by external remote control signal.

	400 kHz	2 MHz	160 MHz
Output Level (freq response) full output	+1.5, –0.5 dB	±0.3 dB	
Harmonics, 50-Ω load	–27 dB		
Discrete Non-Harmonics	–80 dB		
Noise Modulation			
phase, rms*	–63 dB, re 1 rad, (0.5 Hz to 15 kHz)		
amplitude, rms	–75 dB, re 100% (0.5 Hz to 15 kHz)		

* Also see curve.



REMOTE CONTROL: Set by external dc signal of 2 X desired rms output voltage, into > 10 kΩ applied to rear BNC connector. Programming time < 100 μs, to desired level within ±1 dB.

Auxiliary Outputs: Low-level output of dc to 10 MHz at –4 to –6 dBm, with ±0.25-dB flatness, –38 dB distortion. 10 MHz at +6 to +8 dBm into 50 Ω, which can be used to drive another synthesizer, and 1 MHz at 0.8 V pk-pk into 10 kΩ, available at rear BNC connectors. Also, 42 MHz, –4 to –1 dBm; plus 500 to 510 MHz, +15 to +18 dBm, and 500 to 350 MHz, –3 to 0 dBm, (accessible at normally bridged connectors) – available at SMA connectors.

Phase Modulation (optional): Output can be phase modulated ±3 rad from dc to 300 kHz, ±1 rad at 1-MHz modulation frequency, by external signal of 1 V/rad at dc, flat within 2 dB to 300 kHz, into 7.5 kΩ, applied to rear BNC connector.

Accuracy of Fixed Frequency: Equal to that of drive source. Drive source can be internal oscillator or external drive.

Internal Oscillator (optional): MODERATE STABILITY: 5-MHz crystal oscillator. Adjustment range > $5X10^{-5}$ by manual trimmer or > $5X10^{-6}$ by +6- to +9-V external dc signal. Stability is $2X10^{-7}$/°C from +20 to +50°C, $2X10^{-6}$/mo. HIGH STABILITY: 10-MHz crystal oscillator in proportional-control oven. Adjustment range, > $4X10^{-6}$ by manual trimmer or > $5X10^{-7}$ by +6- to +9-V external dc signal. Stability, < $2X10^{-10}$/°C from 0 to +50°C. Drift, $\pm 1X10^{-8}$/wk, < $2X10^{-10}$ with ±10% line-voltage variation; restabilizes typically within $2X10^{-8}$ h after power interruption. Connector provided on rear for battery to maintain oscillator during power interruption.

External Drive (required on models without internal oscillator): 5 or 10 MHz, –5 to +21 dBm into 50 Ω applied to rear BNC connector.

Environment: TEMPERATURE: 0 to +50°C operating. HUMIDITY: 95% at 50°C.

Supplied: Power cord, coaxial patch cord with GR874 connectors, 50-pin plug to mate with rear frequency program connector.

Available: GR874 adaptors, 1452 Programmable Attenuator.

Power: 90 to 110, 104 to 127, 180 to 220, 194 to 236, or 207 to 253 V; 48 to 66 Hz (45 to 48 Hz with high-line limit decreased 5%, 360 to 440 Hz with low-line limit increased 5%); 70 W max. Connection provided for 15- to 18-V, 200-mA, dc source to maintain high-stability oscillator during power interruption.

Mechanical: Bench or rack models. DIMENSIONS (wxhxd): Bench, 19.75x6.9x24.88 in. (502x176x632 mm); rack, 19x5.22x22.88 in. (483x133x569 mm). WEIGHT: Bench, 58 lb (27 kg) net, 69 lb (32 kg) shipping; rack, 50 lb (23 kg) net, 61 lb (28 kg) shipping.

Description	Catalog Number
1061 Frequency Synthesizer, 400 kHz to 160 MHz with 10-kHz resolution and 100-Hz search settability remote control, and external drive only	
Bench Model	
Rack Model	
Options	
OP1 Local Control Panel	
OP2A Moderate-Stability Internal Oscillator	
OP2B High-Stability Internal Oscillator	
OP3 Phase Modulation	
OP4A 1-kHz digit resolution (10-Hz search)	
OP4B 100-Hz digit resolution (1-Hz search)	
OP4C 10-Hz digit resolution (0.1-Hz search)	
OP4D 1-Hz digit resolution (0.01-Hz search)	
OP4E 0.1-Hz digit resolution (0.001-Hz search)	
OP4F 100-Hz digit resolution (economy, 5-ms switching, 100 Hz Search)	
OP4G 1-Hz digit resolution (economy, 5-ms switching, 100 Hz Search)	
Available for customer installation	
Digit Insertion Kit*	1169-9600

* Additional digits of resolution may be added to any synthesizer equipped with options 4A through 4D.

U.S. Patent Number 3,509,483.

Introduction—Section 1

1.1 GENERAL 1-1
1.2 DESCRIPTION 1-1
1.3 CONTROLS, INDICATORS, AND CONNECTORS 1-2
1.4 SYSTEMS 1-2
1.5 ACCESSORIES SUPPLIED 1-2
1.6 ACCESSORIES AVAILABLE 1-2

1.1 GENERAL.

The Type 1061 Frequency Synthesizer generates highly stable, accurate frequencies from 0.4 to 160 MHz at an output level of 0 to +20 dBm. The output frequency is derived from a single source by a series of arithmetic operations on frequency (addition, subtraction, multiplication, and division). Phase-locked oscillators are used for stepped-digit frequency selection.

A continuously adjustable decade, hereafter referred to as CAD, is a built-in feature. The frequency of the selected decade is continuously variable or programmable from −1 to +10 digits. Any decade 1 MHz and smaller can be "searched" via an external analog voltage. Remote selection of the searched decade is accomplished by programming a 10 in BCD (8 + 2) for that particular decade.

Signal-to-phase-noise ratio is greater than 63 dB for a noise bandwidth that extends from 0.5 Hz to 15 kHz on each side of the output frequency. The signal-to-amplitude-noise ratio is 75 dB for the same noise bandwidth. Frequency programming, at switching speeds of less than 100 μs per digit, is easily accomplished with BCD control signals.

This synthesizer is structured to permit custom tailoring for a particular need via performance-level and frequency-resolution options. The basic instrument has 10-kHz resolution, a sweep/search capability, programmability, requires an external reference oscillator, and has a blank front panel (no means of local control). Option 1 is a local-control feature (i.e., a full complement of front-panel, rotary-in-line switches for manual control of output frequency), pushbutton search access with manual continuously variable search controls, and manual control of output level. Option 2A is a room-temperature reference oscillator; 2B is a precision reference oscillator. Option 3 provides phase-modulation capability. Options 4A through 4E provide a choice of 5 resolutions with 100 μs programming-response time. Options 4F and 4G are the same as 4B and 4D except the programming-response time is limited to 5 ms and there is no search provision other than that provided by the basic instrument. (Refer to the specifications for details).

A variety of applications exist for the synthesizer in advanced communications, spectrum analysis, physical, medical, and other areas of research. Applications information can be found in the GR reprint Form Number JN441-173 available upon request to General Radio Company.

1.2 DESCRIPTION

1.2.1 Electrical.

Instead of substituting a variable oscillator for a decade digit, as many other synthesizers do the 1061 uses its oscillators in an unlocked mode to superimpose a variable-frequency component on the output of a selected digit.

Any decade with 1 MHz and smaller steps can be "searched" via an external analog voltage. The frequency of the selected decade is continuously variable from its −1 to +10 digit. The voltage required varies from −0.5 V to +5 V for the −1 to +10 digit range. When the 10-kHz/step decade is "searched", the basic 1061 has 100-Hz settability.

In other words, the search feature extends the resolution (settability)of the synthesizer to 1% of the smallest decade step.

The (remote) selection of the decade "searched" is accomplished by programming a 10 in BCD for the particular decade.

With the FREQUENCY SELECT control set to LOCAL (option-1 instrument) the output frequency is selected by the front-panel controls. In the REMOTE position, frequency selection is by 8-4-2-1 binary-coded decimal (search :8 + 2). Negative logic is used and the logic levels are: 0 = 5 V at 0 mA; 1 = 0 to 0.5 V at 3 mA. These levels are compatible with standard TTL integrated logic circuits.

For the basic instrument the 0 to +20 dBm output is controlled via a rear-panel BNC input, and leveled to within ≈ ±1 dB. The RMS output level is related to the program voltage by a factor of 0.5. For example, a voltage of 4.48 V will produce an output of 2.24 V rms or +20 dBm (2.24 V into 50 Ω is +20 dBm).

For option-1 instruments, the output level is 0.224–2.24 V (0 to +20 dBm) from a 50-Ω source impedance. It is available at a front- or rear-panel GR874® recessed locking coaxial connector. The level is continuously adjustable over a 20-dB range providing ±1.5 dB accuracy. At full output the response is flat within +1.5, –0.5 from 0.4 to 2 MHz and ±0.3 dB from 2 to 160 MHz.

An external source is required to drive the basic (or slave-version) instrument. It can be a synthesizer containing option 2A or 2B, another slave version, or any other precision 5- or 10-MHz source. Any number of slave synthesizers can be cascaded, if the first one is driven by a suitable external source.

An instrument containing option 2A has a room-temperature reference oscillator with a stability factor of $2 \times 10^{-7}/°C$ from 20°C to 50°C. The electrical adjustment range is 5×10^{-6} from +6 to +9 Vdc. If better accuracy is required, this oscillator can be switched out and replaced by an external source.

An instrument containing option 2B has a precision reference oscillator with a stability factor of $2 \times 10^{-10}/°C$ from 0°C to 50°C. The electrical adjustment range is $> 5 \times 10^{-7}$ from +6 to +9 Vdc. Drift is $\leq 1 \times 10^{-8}$/week; approximately 1×10^{-9}/day after 1 month of continuous operation. Within 2 hours after a power interruption, the oscillator will restabilize typically to within 1×10^{-8}. This unit can also be switch substituted.

The external source referred to above must be either 5.0 or 10.0 MHz and its level 0.13 to 2.5 V (–5 to +21 dBm) into 50 Ω. A rear-panel BNC jack provides the connection.

A rear-panel input (labeled PHASE MOD IN) is used to allow modulation of the carrier (option-3 instrument only). Phase modulation is a type of fm where the frequency deviation and the rate are interdependent. In other words, the frequency and amplitude of the modulating signal determine the fm deviation. The relationship is dependent upon the phase-modulation characteristics. For example, the output can be phase modulated ±3 radians from dc to 300 kHz. In terms of fm, this means that if you modulate with a 1-kHz signal (rate) at the maximum ±3-V amplitude, the equivalent fm deviation is ±3 times 1 kHz or ±3 kHz.

There are two types of resolution options. Options 4A through 4D are referred to as standard options; 4F and 4G are "economy" options. They cannot be mixed because separate mother boards are involved. General Radio Company encourages the purchase of option 4A or 4F initially. They include the appropriate mother board and facilitate adding more resolution later without returning the instrument to the factory. Digital-insertion kits are available for this purpose.

It is probably obvious that the resolution options are cumulative. A 1-Hz resolution synthesizer (option 4D) contains the 10-Hz, 100-Hz, and 1-kHz options.

1.2.2 Mechanical.

Large in-line numerals behind windows in the front panel indicate the manually-selected frequency.

The instrument is available in either a bench cabinet or an EIA standard RS-310, 19-in. relay rack. Mounting instructions are given in Section 2 and include converting from one model to the other.

1.3 CONTROLS, INDICATORS, AND CONNECTORS.

Tables 1-1 and 1-2 list and describe the front- and rear-panel controls, indicators and connectors. Refer to the illustrations of Figures 1-1 and 1-2.

1.4 SYSTEMS.

Since additional equipment can expand the basic capabilities of most General Radio instruments, including the synthesizer, arrangements are available to supply complete systems; inquiries are invited. Each system, custom tailored to individual requirements and including only the equipment necessary to perform the required task, is completely assembled and checked as a unit. Such systems have wide application and can be used for laboratory development, production monitoring, final quality assurance, production-lot sorting, incoming inspection, environmental testing, reliability evaluation, etc., on an automatic or semi-automatic basis.

1.5 ACCESSORIES SUPPLIED.

Table 1-3 lists the accessories supplied with the Synthesizer.

1.6 ACCESSORIES AVAILABLE.

1.6.1 Programmable Attenuator — Type 1452.

The GR 1452 programmable coaxial attenuator can be used to attenuate the synthesizer output by known amounts

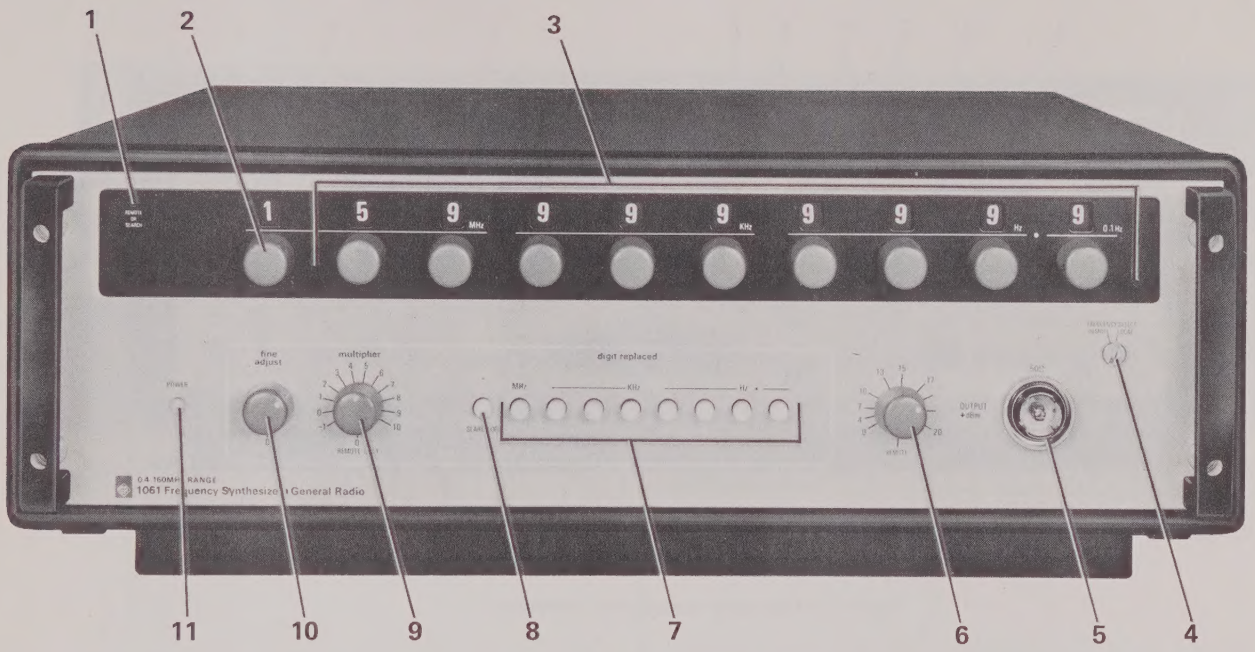


Figure 1-1. Front panel controls, connectors and indicators for synthesizer with option 1.

Table 1-1

FRONT-PANEL CONTROLS, INDICATORS, AND CONNECTORS

Fig 1-1 Item	Name	Description	Function	Remarks
1	REMOTE OR SEARCH	Red panel lamp	NOTE Items 1-10 characterize option-1 instruments. Indicates remote or search operation	Lights when FREQUENCY SELECT control is set to REMOTE or a SEARCH pushbutton is depressed.
2 and 3	——	Frequency knob/dial assemblies. (Item 2) has 2-pos. switch; (item 3) has 10-pos. switches.	(Item 2) provides local control of most-significant digit; (item 3) all other digits.	Not effective in REMOTE mode of operation.
4	FREQUENCY SELECT	Switch, 2 pos., labeled: REMOTE, LOCAL.	Selects local or remote frequency control.	Energizes REMOTE lamp when set to REMOTE.
5	OUTPUT 50 Ω	GR874®, low-loss, quick-connect connector.	External connection for output signal.	May be alternatively mounted on rear panel.
6	OUTPUT dBm	Calibrated rotary potentiometer, panel marked from extreme ccw position: REMOTE, 0, 4, 7, 10, 13, 15, 17 and 20.	Controls and indicates the r-f output into 50 Ω.	REMOTE position transfers control to rear-panel BNC connector (Item 16).
7	DIGIT REPLACED, Hz	Pushbutton switches; panel marked: X.1, X1, X10, X100 Hz; X1, X10, X100 kHz, and X1 MHz.	Replaces step digit indicated by panel marking with continuously adjustable search/sweep capability.	Range of frequency control of selected decade is −1 to +10 times the replaced step digit.
8	SEARCH OFF	Pushbutton switch	Disables the search capability by releasing all digit replaced buttons when depressed.	
9	MULTIPLIER	Calibrated rotary potentiometer. Panel marked: REMOTE ONLY, −1, 0, 1, 2, 3, ... 9, 10.	Controls and indicates the replaced digit.	Multiply the pushbutton-selected digit-replaced value by the setting of this control.
10	FINE ADJUST	Rotary potentiometer, continuously adjustable, "0" position indicated by panel marking.	Uncalibrated vernier on above.	Use to obtain the ultimate settability of frequency. Set to 0 for max multiplier accuracy.
11	POWER	White panel lamp	Indicates instrument is on.	Turn-on accomplished when line cord is connected. There is no power switch.

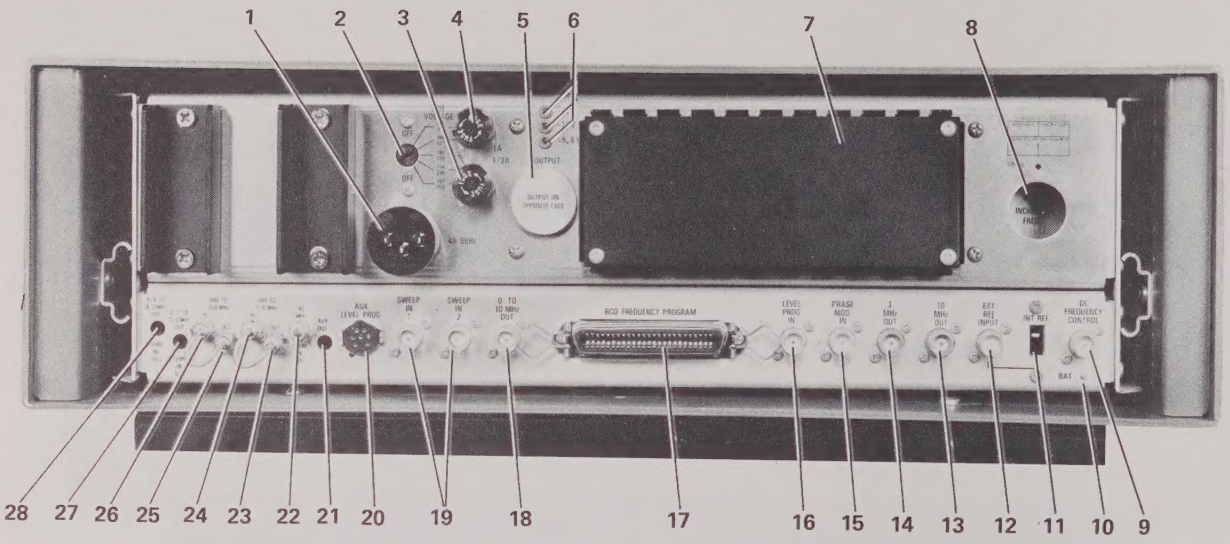


Figure 1-2. Rear apron controls and connectors.

Table 1-2

REAR-PANEL CONTROLS AND CONNECTORS

Fig 1-2 Item	Name	Description	Function	Remarks
1	——	Safety type line-voltage plug, 3-wire (IEC Standard)	Accepts 3-wire ac-line cord, Belden SPH-386 or equivalent	Use GR Power Cord P/N 4200-9625
2	LINE VOLTAGE	Rotary switch, 7 position	Switches line-voltage connection to one of 5 ranges or off.	Panel labeled: OFF, 90-110, 104-127, 180-220, 194-236, 207-253, and OFF.
3	FUSE/½ A	Extractor-post, fuse holder	Protects instrument on 3 highest line-voltage ranges.	
4	FUSE/1 A	Extractor post fuse holder	Protects instrument on 2 lowest line-voltage ranges.	
5	——	Removable disc	Used to cover vacant front- or rear-panel OUTPUT connector hole.	Labeled: output on opposite face.
6	——	Pin jacks, 0.80 in. dia.	Three power supply test points	Panel labeled: +18 V, −12 V, and +5.6 V.
7	——	Metal cover	Cover for power transistors and power-supply adjustments.	Remove cover to obtain access to the power transistor or the +18 V, −12 V, and +5.6 V adjustments.
8	——	Screwdriver-type adjustment	Frequency adjustment for reference oscillator.	Option 2B instrument only.
9	DC FREQUENCY CONTROL	BNC jack connector	Input connection for dc control of internal reference oscillator frequency.	+6 to +9 V, internally biased to +8 V. $\Delta F > 5X10^{-6}$, op2A-$_7$ $\Delta F > 5X10^{-7}$, op 2B.
10	BAT	Pin jack, .08 in.	External battery connection to maintain constant crystal oven temperature in the reference oscillator during power interruption.	15-18 V, 0.2 A max.
11	INT/EXT REF	Slide switch, 2-position.	Permits a choice of internal or external drive.	Disconnects internal reference oscillator when set set to EXT REF INPUT position.
12	EXT REF INPUT	BNC jack	Input connection for external reference oscillator.	A 5- or 10-MHz external standard at 0.13 V to 2.5 V into 50 Ω (−5 to +21 dBm).
13	10 MHz OUT	BNC jack	Connection for 10-MHz output signal	Derived from reference-oscillator source. Level is 0.5 V ±11% into 50 Ω (+6 to +8 dBm).

Table 1-2 (cont)

REAR-PANEL CONTROLS AND CONNECTORS

Fig 1-2 Item	Name	Description	Function	Remarks
14	1 MHz OUT	BNC jack	Connection for 1-MHz output signal	Derived from reference oscillator source. Level is 0.8 V pp into 10 kΩ.
15	PHASE MOD IN	BNC jack	Connection for phase-modulation-input signal.	(see specifications)
16	LEVEL PROGRAM IN	BNC jack	Connection for remote control of output level.	RMS output voltage is 0.5 of positive dc program voltage (accuracy is ±1.5 dB; level is 0 dBm to +20 dBm) into 10 kΩ; less than 100 μs programming response time to within 1 dB of final value. (See also item 6, front panel.)
17	BCD FREQUENCY PROGRAM	Amphenol, Type 57 connector, 50-pin	Connection for BCD frequency program input signals.	See Figure 2-5.
18	0 to 10 MHz OUT	BNC jack	Connection to auxiliary 0 to 10 MHz output.	Level fixed at 0.125 V ± 10% into 50 Ω.
19	SWEEP IN	BNC jacks labeled 1 and 2	Connections for 2 summing inputs for external control of sweep.	Range of control is −1 to +10 times the replaced stepped digit. Sensitivity is 0.5 V/digit with maximum nonlinearity of ± 0.3 digits. Sweep (FM) rate: 0 to 20 kHz; Distortion 6% max. (3% at 5 kHz).
20	AUX LEVEL PROG	A 7-pin jack that mates with Amphenol type 126-195 plug connector	May be specially wired for System applications	
21	BLANK			
22	42 MHz	SMA jack, Terminated in 50 Ω *	Provides output for system applications	These connections may be used as test points to check internal operation in trouble shooting. See detailed block diagram for normal signal levels. CAUTION Outputs require terminations for proper operation of synthesizer.
23	500 to 510 MHz OUT	SMA jack, looped to 24	Provides output for system applications	
24	500 to 510 MHz IN	SMA jack, looped to 23	Provides output for system applications	
25	500 to 350 MHz OUT	SMA jack, looped to 26	Provides output for system applications	
26	500 to 350 MHz IN	SMA jack, looped to 25	Provides output for system applications	
27	BLANK			
28	BLANK			

*Terminate with coaxial 50 Ω load in SMA connector series. Use Model 4110-P Mfg. by EMC Technology Corp., 1300 Arch St., Phila., Pa.

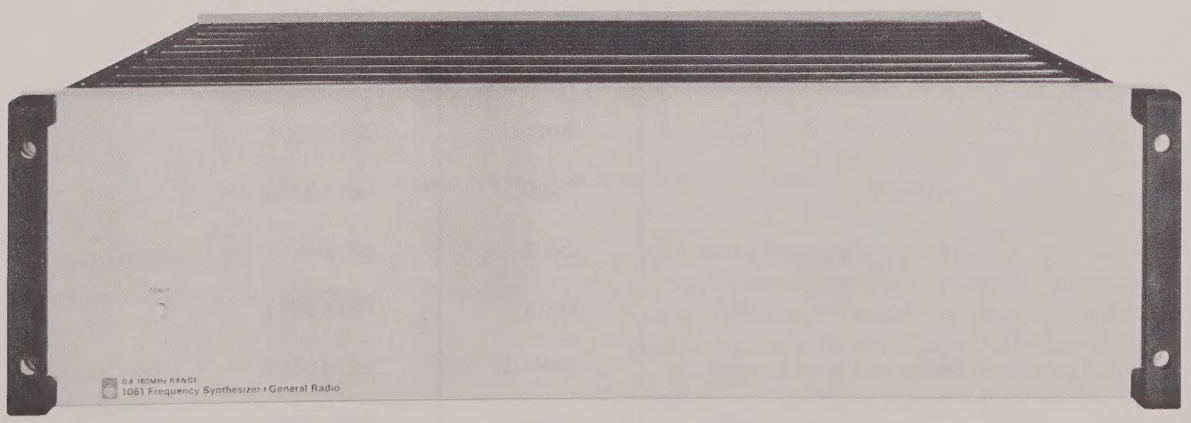


Figure 1-3. Basic synthesizer in rack version equipped for remote control and external drive only. Can include all options except option 1.

in response to binary coded control signals (or front-panel switch settings). The resolution of the instrument — smallest calibrated step — is 1 dB; the total attenuation is 80 dB and the operating frequency range is 10 kHz to 500 MHz. The accuracy of the attenuator, over the frequency range of the synthesizer, is approximately 1% of setting + 0.4 dB.

1.6.2 Coaxial Adaptors.

As with similar General Radio equipment, the synthesizers use the quick-connect GR874 coaxial connector. However, for the user wishing to mate the instruments with components fitted with coaxial connectors of some other series, it is a simple matter to adapt to that series.

GR874 adaptors to leading commercial and military coaxial series (or to binding posts) are available to convert to the desired type. These adaptors are listed in Table 1-4.

Over-all VSWR of the converted GR874 connector is typically no greater than that of the other-series connector by itself, and leakage at the GR874 junction is typically >120 dB down.

1.6.3 75-Ω Matching Pad.

The Type 874-MP Matching Pad is a two port, minimum loss, resistive network with a typical loss of 5.72 dB. Each end of the pad is fitted with a GR874 locking connector. The principal application is the conversion of the GR874 OUTPUT connector of the synthesizer from a 50-Ω to a 75-Ω impedance.

The frequency range of the pad is dc to 1 GHz and it can be used to 8.5 GHz. The maximum power rating is 1 W continuous.

For more information on a complete line of coaxial adaptors, consult your General Radio catalog.

Table 1-3

ACCESSORIES SUPPLIED

Name	Description	Part Number
Power Cord	7-feet, 3-wire	4200-9625
Coaxial Patch cord	3-feet, Type 874-R22LA	0874-9683
FREQ PROGRAM Connector	50-pin, Amphenol Type 57	Amphenol P/N 57-30500

Table 1-4

GR874 ADAPTORS

TO TYPE		TYPE 874†	GR PART NUMBER
APC-7		QAP7L	0874-9791
BNC	plug	QBJL	0874-9701
	jack	QBPAL	0874-9801
GR900®		Q900L	0874-9709
N	plug	QNJL	0874-9711
	jack	QNPL	0874-9811
SMA	plug	QMMJL	0874-9723
	jack	QMMPL	0874-9823

† Locking GR874 Connector.

Example: To connect Type 874 to a type-N jack, order Type 874-QNPL

Installation—Section 2

2.1 DIMENSIONS 2-1
2.2 MOUNTING 2-1
2.3 REMOTE PROGRAMMING CONNECTIONS 2-3
2.4 POWER-LINE CONNECTION 2-4
2.5 LINE-VOLTAGE REGULATION 2-4
2.6 ENVIRONMENTAL CONDITIONS 2-4
2.7 EXTERNAL CONNECTORS 2-5
2.8 UNPACKING AND INSPECTION 2-6
2.9 STORAGE AND SHIPMENT 2-6

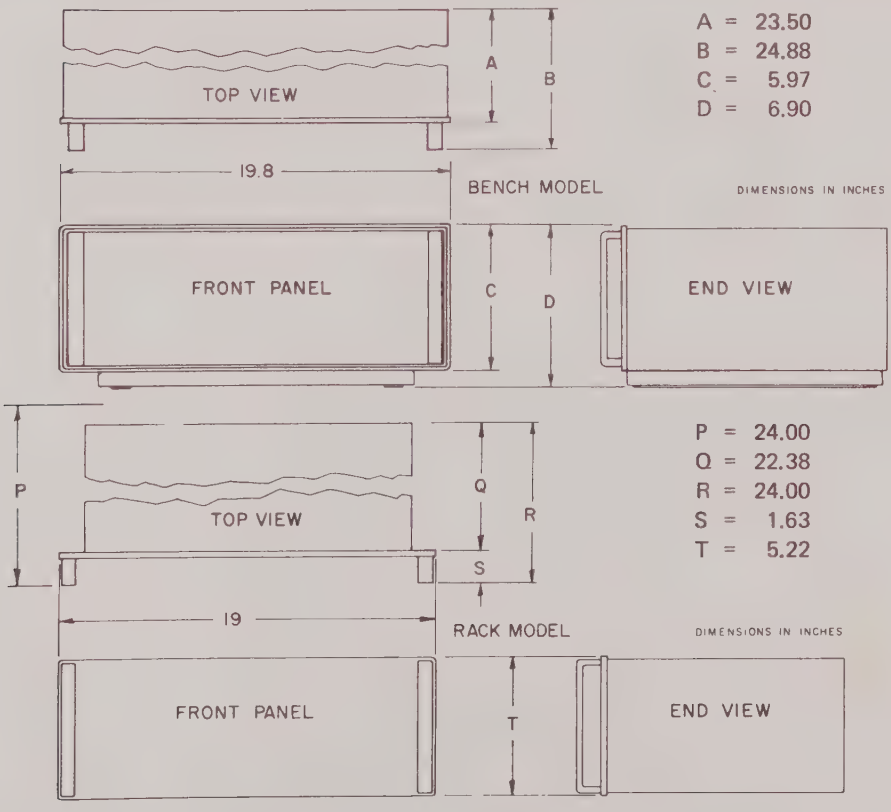


Figure 2-1. Dimensions of the Synthesizer (inches).

2.1 DIMENSIONS.

Dimensions of the rack and bench models are shown in Figure 2-1.

2.2 MOUNTING.

2.2.1 General.

The unit is available in two models, bench mount and relay-rack mount, either of which can be converted to the other by the installation of a simple conversion set.

2.2.2 Bench Mounting.

The bench-mount cabinet is made of formed and welded 1/8-in. aluminum finished in baked-on, medium gray crackle paint and has a tilt base. The instrument is retained in the case by four front-panel screws accessible through holes in the carrying handles. To remove the instrument from its case, remove the four front-panel screws and withdraw the instrument. Slide blocks on the instrument engage tracks in the case to guide insertion and withdrawal.

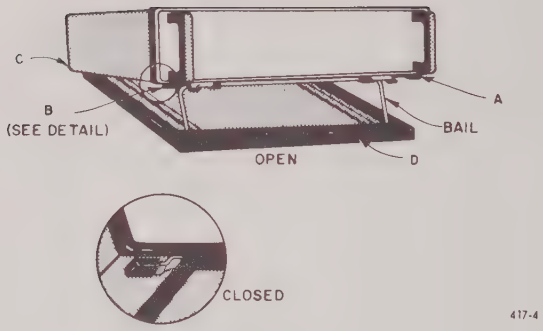


Figure 2-2. The bail can be used to tilt the instrument, providing a better view of the front-panel indicators.

To insert the instrument into the case, straddle the tracks with the rear guide blocks and push all the way into the case. Secure the four front-panel screws.

WARNING

When tilting the instrument or removing the tilt, do not allow your fingers to come between the cabinet and its base.

2.2.3 Tilting.

The bench models of the synthesizer are delivered completely assembled in a metal cabinet, ready for bench use. A convenient bail, located along the bottom front edge of the instrument, can be pulled down to raise the front and provide a better view of the front-panel indicators (see Figure 2-2). To tilt the instrument, proceed as follows:

a. Place the right thumb on the right-hand release toggle (A) and the left thumb on the left-hand release toggle (B) under the front corners of the instrument.

b. Push both release toggles toward the rear as far as they will go.

c. Using the rear of the base (C) as a pivot, lift the front of the instrument, permitting the bail to drop down on the base.

d. With one hand, hold the instrument in the tilted position; with the other, pull the bail forward as far as it will go and carefully lower the instrument. The bail is now locked in place and the instrument will remain in the tilted position.

Reverse this procedure to eliminate the tilt. Be sure the toggles are pushed back, toward the rear of the instrument. Then lower the front carefully onto the base. Lock the base to the bottom of the instrument by sliding the toggles (A and B) forward.

2.2.4 Cabinet Removal.

To remove a bench-model instrument from its cabinet:

Remove the four panel screws (A, Figure 2-3), P/N 7270-6310, two on each side of the front panel. These are No. 10-32, 9/16-in. screws, with nylon washers. To loosen them, insert a Phillips-head screwdriver through the holes in the handles, shown in the figure. Then pull the instrument forward, out of the cabinet.

2.2.5 Conversion to Rack Mounting.

The following procedure is used to convert a bench model to a rack-mounted model.

a. Order rack-cabinet assembly (P/N 4174-3743), a hardware set (P/N 4174-2002), and a rear cover (P/N 4171-1169), and rear brackets (P/N 4179-8803).

b. Disconnect any external cables, remove the front-panel screws and withdraw the instrument from the case.

c. Install the rack-cabinet in the relay rack and insert the instrument.

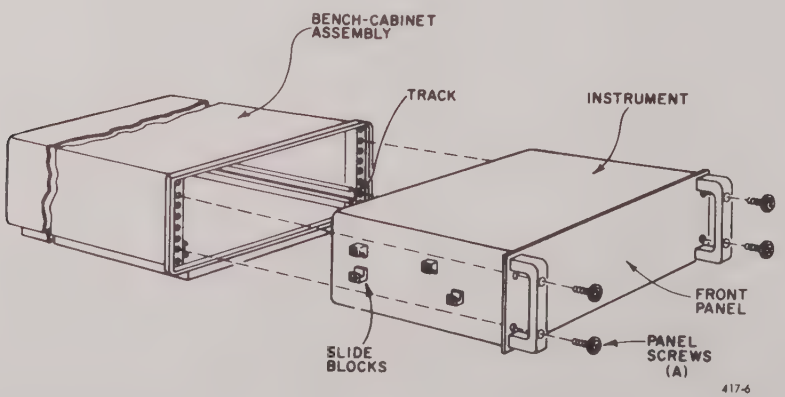


Figure 2-3. Bench cabinet assembly.

2.2.6 Rack Mounting.

A rack-mounting case (Figure 2-4) with installation hardware is provided with a rack-mount model. To install this model in a standard 19-in. relay-rack proceed as follows:

a. Remove the panel screws and withdraw the instrument until it stops. Lift the front and withdraw completely from the cabinet.

b. Insert the cabinet into the rack and secure it to the front of the rack with the four screws provided.

c. If the rack contains a rear support, remove the rear-cover screws and the rear cover from the case. Attach the brackets to the inner holes on the cabinet with the rear bracket screws and nuts provided. Use the set of slots that most nearly align the bracket with the rear support of the rack. Secure the brackets to the rack, each with two screws and nuts provided.

d. Push the track all the way into the case. Place the rear of the instrument into the cabinet, lifting it to straddle the tracks with the slide blocks. Push the instrument into the case until it stops. Lift the front, pull the instrument out so that the tracks follow and then push in so that the front slide blocks straddle the tracks. Slide the instrument all the way into the case and secure with four front-panel screws.

2.2.7 Conversion to Bench Mounting.

a. Order a 4173-4014 bench cabinet assembly (includes hardware set).

b. Disconnect any cables from the instrument, remove the front panel screws and withdraw the instrument from the rack cabinet.

c. Insert the instrument into the bench cabinet, straddling the tracks with the slide blocks. Secure the instrument with the four front-panel screws.

2.3 REMOTE PROGRAMMING CONNECTIONS.

2.3.1 General.

Both the master and slave versions of the unit can be programmed for remote control of output frequency and output level. Table 2-1 lists the three variations of the remote control mode.

Table 2-1

REMOTE-CONTROL-MODE VARIATIONS

OUTPUT	
Frequency	**Voltage**
Local	Remote
Remote	Local
Remote	Remote

2.3.2 BCD FREQUENCY PROGRAM Socket.

Frequency programming connections are made to the rear-panel BCD FREQUENCY PROGRAM socket (Figure 1-2). This 50-pin Amphenol Type 57 socket (GR P/N 4230-4049) mates with a 50-pin Amphenol Type 57 plug (Amphenol P/N 57-30500).

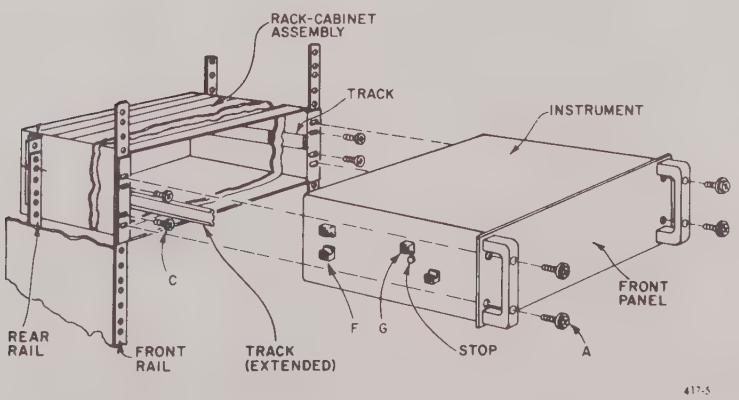


Figure 2-4. Method of mounting the relay-rack model.

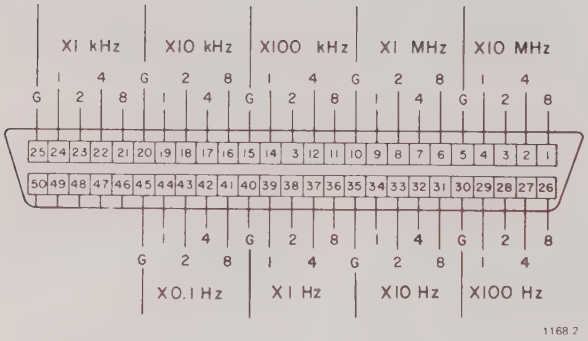


Figure 2-5. BCD FREQUENCY PROGRAM socket connections as viewed from the rear of the instrument.

The information provided in Figure 2-5 can be used to assemble a cable through which the synthesizer can be programmed. Connections can be made with any electrical wire or cable but it is recommended that 4-wire shielded cable be used — a separate one for each frequency decade. A separate ground terminal is provided adjacent to each group of four terminals, which can be used for connecting the shield of each cable. Cable resistance is completely negligible for lengths up to 100 ft.

The color-coding of the recommended cable-conductors should match the 1-2-4-8 code (brown, red, yellow, and grey) for easy identification within a cable. It is suggested that the individual cables be marked with color bands at each end to identify the rank of the decade it connects.

A strain relief should be used under the plug clamp to relieve the cable of strain and to avoid pinching the wires when the clamp is tightened. A simple strain relief can be made by wrapping electrical tape around the cable assembly and tightening the clamp around the tape.

All external frequency selection is by 1-2-4-8 BCD control with external program connections provided by a rear-panel multiple contact plug. Logic levels are +5 V for logic "0" and +0.5 V or less for logic "1". An internal 2-kΩ pull-up resistor is provided to keep all program lines at logic "0" unless the external circuit is completed to ground; 3 mA or less will program a logic 1. These levels are compatible with external DTL or TTL integrated circuit gates or inverters.

The switching speed for 10-kHz and above is < 100 μs; below 10 kHz steps it is also < 100 μs, except for economy resolution options 4F and 4G, where it is < 5 ms.

2.3.3 LEVEL PROGRAM Connector.

The output level is set by an external dc signal applied to the rear-panel LEVEL PROG IN connector of 2x the desired rms output voltage. Programming response time is $<$ 100 μs to within ±1 dB of the desired level. The input impedance is 10 kΩ. The synthesizer output into 50 Ω, from a 50-Ω source impedance, is 0 to +20 dBm (or 0.224 to 2.24 V).

2.4 POWER-LINE CONNECTION.

The power-transformer primary windings can be switched, by means of the five-position switch (Figure 1-2) on the rear panel, to accept a line voltages of 90-110, 104-127, 180-220, 194-236, or 207-253 V. Operation at line frequencies up to 440 Hz, with lower line voltage limits increased by 5%, or down to 45 Hz with upper limits reduced by 5%, is satisfactory.

Connect the 3-wire power cable (P/N 4200-9625) to the line and to the 3-terminal male connector (Figure 1-2) on the rear panel. A 1-A fuse is used at the 2 low voltages. A 0.5-A fuse is used at the 3 higher voltages. Power consumption is 70 W max.

2.5 LINE-VOLTAGE REGULATION.

The accuracy of measurements accomplished with precision electronic test equipment operated from ac line sources can often be seriously degraded by fluctuations in primary input power. Line-voltage variations of ±15% are commonly encountered, even in laboratory environments. Although most modern electronic instruments incorporate some degree of regulation, possible power-source problems should be considered for every instrumentation setup. The use of line-voltage regulators between power lines and the test equipment is recommended as the only sure way to rule out the effects on measurement data of variations in line voltage.

The General Radio Type 1591 Variac® Automatic Voltage Regulator is a compact and inexpensive equipment capable of holding ac line voltage within 0.2% accuracy for input ranges of ±13%. It will assure, for example, that an instrument rated for 100-125 (or 200-250) V can be operated reliably in spite of varying input voltages in the range 85-135 (or 170-270) V. The 1 kVA capacity of the 1591 will handle a rack full of solid-state instrumentation with no distortion of the input waveform. This rugged electromechanical regulator comes in bench or rack-mount versions, each with sockets for standard 2- or 3-wire instrument power cords.

2.6 ENVIRONMENTAL CONDITIONS.

The instrument is designed to operate in a relay rack over the ambient air-temperature range, inside the rack, of 0 to 50°C. When mounted in a bench cabinet the outside air-temperature range is 0 to 50°C. The nonoperating

storage-temperature range is −40°C to +75°C. Permissible maximum relative humidity of the ambient is 95% with the instrument operating. The instrument will withstand normal shock and vibration encountered in nonmobile applications. With more severe vibration conditions, operation may be satisfactory but the General Radio Company should be consulted for recommendations.

2.7 EXTERNAL CONNECTORS.

2.7.1 External Battery Connector.

A pin jack connector, marked BAT, on the rear apron permits a "keep alive" battery (*not supplied*) to be connected to the crystal oven. Any 15 V to 18 V nickel cadmium battery is sufficient.

If used, the battery will maintain the crystal oven temperature in case of a power interruption. Internal diodes isolate the battery during normal operation and provide automatic switchover if ac power is removed.

2.7.2 Level Program.

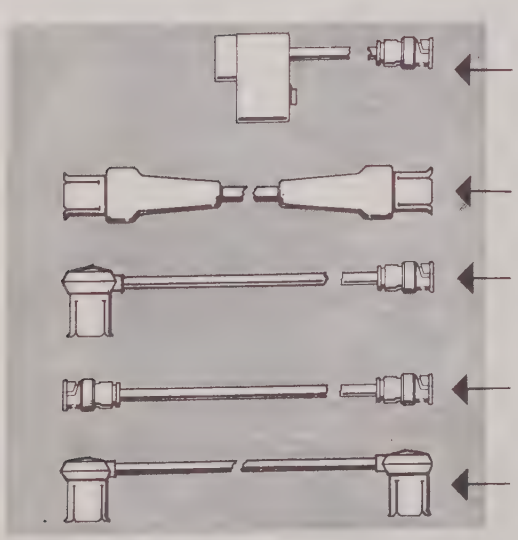
The output level is set by an external dc signal applied to the rear-panel LEVEL PROG IN connector that is 2X the desired rms output voltage. Programming response time is $< 100\ \mu s$ to within ±1 dB of the desired level. The input impedance is 10 kΩ. The synthesizer output into 50 Ω from a 50-Ω source impedance, is 0 to +20 dB (or 0.224 to 2.24 V).

To utilize the level programming feature of an option-1 instrument, set the front-panel OUTPUT control to the REMOTE position. The basic instrument is remote programmed only.

2.7.3 Sweep In.

Two rear panel sweep input connections are provided. Up to ±5 volt signals may be simultaneously applied to these inputs with or without the option 1 panel sweep control on its remote only position. The result of all inputs is summed to produce frequency control of the selected digit. If the range of control is exceeded, internal limiting prevents the frequency from being changed beyond allowable limits. As a result of the summing feature a small amount of fm can be superimposed on a steady dc offset provided by the panel control or a dc input signal; or two f-m rates can be simulaneously applied. The sensitivity to either rear panel input is a frequency charge equal to one digit step for each 0.5 V increment applied, zero digit frequency occuring when the sum of all inputs is 0 V. The input impedance at each input is 30 kΩ.

Table 2-2
AVAILABLE INTERCONNECTION ACCESSORIES



776-A	Patch cord, shielded double plug to BNC plug, 36" long	0776-9701
874-R22A	Coaxial patch cord GR874 to GR874, 36" long	0874-9682
776-B	Patch cord, GR874 (right-angle) to BNC plug, 36" long	0776-9702
776-C	Patch cord, BNC plug to BNC plug, 36" long	0776-9703
776-D	GR874 to GR874, both right-angle, 36" long	0776-9704

274-13XA

2.7.4 Auxiliary Level Program Connections.

A 7-pin connector on the rear apron of the instrument may be wired to accept level-program inputs for special applications. Existing wiring provides an external test point to check the operation of the ALC circuitry.

The apron connector accepts the Amphenol type 126-195 plug, wired as shown in Figure 2-6.

2.8 UNPACKING AND INSPECTION

If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage (scratches, dents, broken knobs, etc.) If the instrument is damaged or fails to meet specifications (Operational Checks, para 3.4), notify the carrier and the nearest General Radio field office (see list at back of this manual). Retain the shipping carton and the padding material for the carrier's inspection.

2.9 STORAGE AND SHIPMENT

2.9.1 Packaging.,

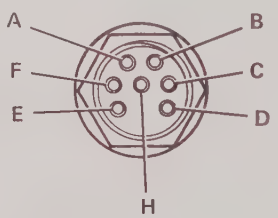
To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Your General Radio field office can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here are two recommended packaging methods:

Rubberized Hair. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument securely in strong corrugated container (350 lb/sq in. bursting test) with 2-in rubberized hair pads, placed along all surfaces of the instrument. Insert fillers between pads and container to ensure a snug fit. Mark the box "Delicate Instrument" and seal with strong tape or metal bands.

Excelsior. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument in strong corrugated container (350 lb/sq in. bursting test) with a layer of excelsior about 6 in. thick, packed firmly against all surfaces of the instrument. Mark the box "Delicate Instrument" and seal with strong tape or metal bands.

2.9.2 Special Reshipment Instructions.

There are no special procedures or facilities required for reshipment of the instrument.



Pin	Function	Remarks
A	No Connection	
B	No Connection	
C	ALC Output – Shield	Chassis Ground
D	No Connection	
E	No Connection	
F	ALC Output – Signal	Test point
H	No Connection	

Figure 2-6. AUX LEVEL PROGRAM socket connections as viewed from the rear of the instrument.

Operation—Section 3

3.1 PRELIMINARY CHECKS 3-1
3.2 INSTRUMENT TURN-ON 3-1
3.3 INSTRUMENT WARM-UP 3-1
3.4 OPERATIONAL CHECKS 3-1
3.5 MODES OF OPERATION 3-2

CAUTION

Do not connect the power cord until the line-voltage switch has been properly set.

3.1 PRELIMINARY CHECKS

Refer to the previous section for a list of the connectors and for tabulation of their functional descriptions. The recommended initial operating procedure follows:

a. Check that the rear-panel line-voltage switch is positioned according to the available power-line voltage. Use the tip of a small screwdriver to turn the switch cw or ccw. The line-voltage frequency must be in the range of 48-66 Hz (except for limited voltage range).

b. Connect the power plug (rear panel) to a suitable power line, using the power cord supplied. The instrument is now on and the front-panel POWER lamp should glow — there is no power switch.

3.2 INSTRUMENT TURN-ON

Because a crystal oven should operate continuously, an on-off power switch is not provided with the synthesizer. Instrument turn-on is accomplished by connecting the a-c line to the rear-panel power connector.

The OP2B synthesizer uses a built-in precision quartz-crystal oscillator for its internal driving source. This crystal is housed in a temperature controlled oven, for optimum oscillator stability, and has a relatively long warm-up interval if the power is interrupted. A rear-panel connector is provided for connecting an external battery to the crystal oven. This connection may be desirable in case of a power failure or if for some reason the unit has to be turned off.

3.3 INSTRUMENT WARM-UP

Since the unit is all solid-state, except for the indicator lamps, no warm-up time is required to generate output. However, in applications where the synthesizer is phase-locked to an already operating external standard, it is necessary to allow complete equipment warm-up to a steady-state condition, if the ultimate in stability is required.

NOTE

Very small frequency errors, due to phase drifts of tuned circuits in the synthesizer, can be important in some demanding applications.

For extremely precise work, a warm-up period of 2 hours or more is recommended for the precision oscillator. When feasible, round-the-clock operation is desirable if high precision is apt to be required on short notice.

3.4 OPERATIONAL CHECKS

NOTE

All operational checks given below assume a remote-only version of the synthsizer or a manual control option instrument set for remote control. It is probably obvious that the checks can be even more readily performed if a manual-controlled instrument is to be checked.

3.4.1 General.

These procedures can be used for incoming inspection, operator familiarization, or as a periodic check on instrument operation.

3.4.2 Proper Frequency Generation

For a quick check of proper frequency generation, use the following procedure:

a. Connect the OUTPUT connection to INPUT A of the 1191/Z Counter. Use a GR 874-QBPAL adaptor and a 776-C patch cord.

b. Using one or more clip leads, ground the various pins of the frequency program plug so as to set the output frequency between 0.4 MHz and 160 MHz.

c. Observe the counter visual register. It should display the same frequency set by the frequency program lines.

A convenient frequency-programming assembly can be constructed, using the 378-series DIGISWITCH. It provides 8-4-2-1 BCD contact closures, for each station that can be

wired, to program up to 10 frequency decades, via a rear-panel connector (Figure 2-5). A DPST switch can be added to all decades through 1 MHz/step, to ground the 8 and 2 lines, to enable sweep operation. An interlocked pushbutton switch assembly is recommended to prevent enabling the sweep on more than 1 decade at a time.

3.4.3 Sweep Check (Figure 2-5)

A center frequency of 10 MHz and a sweep width of 20 kHz are used as an example for this check. Other sweep-width combinations will do as well. A manual sweep, rather than a repetitive sweep voltage, is used so that the output frequency can be read on the counter.

a. Set the frequency program lines for a center frequency of 10 MHz (ground pin No. 4).

b. Program a 10 at the 10-kHz decade (ground pins No. 16 and No. 18).

c. Connect the 1191-Z Counter to the OUTPUT connector.

d. Apply a variable dc voltage from 0 V to +1 V at SWEEP IN 1 and observe the output frequency. The frequency should change from 10.000 to 10.020 MHz. Repeat the measurement using the SWEEP IN 2 connection.

The above procedure can be used for any desired combination of sweep width control settings, as long as the counter resolution is sufficient to read both extremes of the sweep frequency.

3.4.4 OUTPUT Voltage Level

a. Set the synthesizer to any frequency within its output-frequency range.

b. Connect the GR 1806 Electronic Voltmeter, by its -P1 Probe and probe tee terminated in a GR 874-W50BL, 50-Ω termination to the synthesizer OUTPUT connector.

c. Apply a d-c voltage to the synthesizer LEVEL PROG IN connector for maximum output (+4.48 Vdc, +20 dBm = 2.24 V, rms).

d. Observe the 1806 indication, which should be within 10% of 0.5 the applied dc voltage.

3.4.5 Frequency Programming

A switch or solid-state closure to ground will change the program lines from the "0" state to the "1" state. The frequency programming circuits can be functionally checked with a counter and a test lead that has a probe on one end and a clip on the other.

For example, adjust the controls for remote frequency operation and connect the 1191/Z counter to the output connector. Pick a frequency within the frequency range of the synthesizer and refer to Figure 2-5 for its corresponding terminal number. For this example we will use 10 MHz. Clip one end of the test lead to the chassis and touch the probe to terminal 4 of the BCD FREQUENCY PROGRAM socket. Observe the 10-MHz reading on the visual register of the counter. Note that the count disappears as soon as the short to ground is removed. This happens because all lines maintain logic 0 unless a closure to ground is made.

3.4.6 Manual Operation.

With manual-operation (OP1) instruments, a series of dials permits frequency setting with an in-line display of the selected steps. Also, a decade to be searched can be selected by pushbutton and a calibrated panel control permits continuous variation of the frequency. An uncalibrated fine control permits setting the frequency to 1/100th of a step.

3.5 MODES OF OPERATION.

3.5.1 General.

In addition to using the master oscillator as the internal precision frequency source, it can be replaced by an external frequency standard. The sweep capability can be switched on or off and over-all instrument operation can be locally (manually) or remotely controlled.

3.5.2 Master Oscillator.

Internal Drive. In this mode of operation, the internal master oscillator is used as the synthesizer driving source and determines the output frequency stability. To use the oscillator in this manner, set the rear-panel switch to the INT REF position (white marker up).

External Drive. Setting the rear panel slide switch down to EXT REF INPUT disables the internal oscillator and connects the rear-panel connector directly to an amplifier, in the synthesizer. This method of operation is useful in case of internal oscillator failure or power interruptions that impair oscillator stability. With no internal oscillator, this is the only means of operation.

Make the connection and set the control as follows the external-drive operation:

Slide Switch . . . . . EXT REF INPUT
EXT REF INPUT . . . Connect a 5-MHz or 10-MHz Precision Source*

***The external drive level must be 0.13 V to 2.5 V into 50 Ω at rear panel BNC Connector.**

Theory–Section 4

4.1 GENERAL 4-1
4.2 SYNTHESIZING PROCESS 4-1
4.3 DETAILED CIRCUIT ANALYSIS 4-2

4.1 GENERAL.

This section contains a functional description to the functional-diagram level of Figures 6-3 and 6-4, and a more detailed circuit analysis. For a detailed block diagram, with each block representing a physical part of the instrument, refer to Figures 6-5, 6-6, and 6-7.

Para. 4.2 is a functional-diagram-level description of circuit operation. The more detailed circuit analysis (para. 4.3) has a separate paragraph for each section and uses both sectional and functional names to refer to a particular section. Included in each paragraph title is a reference to the schematic for that section.

4.2 SYNTHESIZING PROCESS.

The synthesizer derives its output frequency from a single reference source by means of arithmetic operations on frequency (addition, subtraction, multiplication and division). In standard-resolution options, a separate phase-locked oscillator is used for each digit of resolution. In economy-resolution options, dual decade "scale-of-n" type phase-locked oscillators are used for step resolution of 1 kHz down to 1 Hz.

In the single-decade phase-locked oscillators, for 1-MHz steps and smaller, search/sweep capability is provided. This mode is enabled by programming 8 + 2 on the BCD control input, which disables the phase-lock and connects the external sweep input to the varactor control of that particular oscillator. The sweep input is processed by a common-drive circuit, which compensates for the identical, though nonlinear, varactor-control characteristics of the various digit oscillators.

Since the economy-resolution option synthesizers use different digit oscillators below the 10-kHz step decade, the search capability in such instruments is limited to the 1-MHz, 100-kHz and 10-kHz decades. The iterative circuit shown in the lower right corner of the functional diagram is used in all lower decades for the standard-resolution options. Refer to the economy-resolution functional diagram (Figure 6-3) for the circuit used in economy-resolution options.

The synthesizing process is controlled by a common-master oscillator, or by an external source of either 5 or 10 MHz. Two master oscillators are available, a moderate stability 5-MHz nontemperature-controlled crystal oscillator, OP2A, or a high-stability 10-MHz precision-crystal oscillator in a proportionally controlled oven, OP2B.

Either oscillator can be controlled over a limited frequency range by an external dc voltage for tracking, locking or offsetting the frequency by external circuitry. No internal locking circuits are provided. A rear-panel switch permits selection of the internal master oscillator, if installed, or an external reference source applied at a rear-panel connector.

The reference signal from the internal master oscillator or the external reference is doubled in frequency (if 5 MHz), limited, and passed through a 1-kHz bandwidth monolithic crystal filter, to provide a clean 10-MHz reference for the synthesizer. Frequency dividers furnish 5 MHz to the first mixer in the synthesizing process and the 1 MHz phase-lock reference for all digit-oscillator steps of 1 MHz and smaller.

The 10-MHz signal is converted into a short pulse to generate all other fixed reference frequencies. This pulse is used directly as the phase-lock reference for the 10-MHz digit steps, and its 70-MHz component is used to drive a frequency divider-multiplier combination to produce a 42-MHz reference for the earlier synthesis circuits. The same 70-MHz signal is multiplied by 6 to produce the 420-MHz reference for the next-to-last up-conversion in the combining process, for 1 MHz and smaller digit steps. An optional phase modulator (OP3) can be installed ahead of the X6 multiplier.

In the 10-kHz per-step decade, and lower decades for standard-resolution options, the synthesis process consists

of adding 5 to 5.1 MHz to 42 MHz to produce 47 to 47.1 MHz. Then, a selected 100-kHz step of a 3 to 3.9 MHz phase-locked oscillator is added to produce a frequency in the 50-to 51-MHz range, which is divided by 10 to produce an output in the 5-to 5.1-MHz range. Such a process can be repeated indefinitely and produces a series of successive decades of frequency control. The first mixer in the chain is supplied with a 5-MHz fixed frequency to start the process. When search/sweep is enabled for a particular decade, its frequency is continuously adjustable by an external control voltage, instead of being precisely detented by the phase-lock loop.

In the economy resolution options, 2 decades of frequency control are supplied by each oscillator. When 2 such oscillators are used, it is necessary to effect an additional 10-to-1 frequency division, between the points where their frequencies are inserted, to retain the proper relationship of frequency contributions. This is accomplished by adding 45 MHz (9 X 5 MHz) to the 5 to 5.1 MHz output of the second mixer to produce 50 to 50.1 MHz, then dividing by 10 to produce 5 to 5.01 MHz. The process otherwise remains the same as that previously described, except that each digit oscillator produces one of one hundred 10-kHz steps in the 3 to 3.99 MHz range and no search/sweep input to these oscillators is possible.

The 100-kHz-per-step-decade signal processing is similar to that described for the 10-kHz decade, except that the 50- to 51-MHz output from the second mixer is not divided by 10; consequently the steps generated by the digit oscillator for this decade are the same as those provided by the oscillator itself, or 100 kHz.

The 1-MHz-per-step decade signal processing is the same as that described for the 100-kHz decade but all frequencies involved are 10 times higher, including the 1-MHz steps in the 30- to 39-MHz range from the digit oscillator.

The 500- to 510-MHz output contains all digit information of the 1 MHz and smaller steps in the synthesizer.

The 10 MHz steps are obtained directly from a 500 to 350 MHz digit oscillator programmed to one of sixteen 10-MHz steps. For external control all combinations of the 4-bit binary input are used. To provide a decimal readout on the local control option, two interlocked switches are used to provide the proper binary control signals. The zero step programs a 500-MHz oscillator frequency, and each successive input step produces a 10-MHz lower frequency, down to 350 MHz on step 15.

To produce the output frequency of the synthesizer, the 500-to-350-MHz signal, in 10-MHz steps, is subtracted from the 500-to-510 MHz signal, with 1-MHz and smaller steps. The low frequency is limited to 400 kHz by level control considerations in the high-level output amplifier but a separate output system provides a low-level output from 10 MHz down to dc. The actual digital high frequency limit for step programming is somewhat determined by the resolution option, being 159.99 MHz for the minimum 10 kHz option (9.99 MHz on the low-level output).

4.3 DETAILED CIRCUIT ANALYSIS.

4.3.1 Panel Circuit. (Figure 6-8).

The front panel on remote-only options carries only a pilot light to indicate that line power is being supplied to the instrument. Figure 6-8 is a schematic showing all the wiring and controls for a local-control front panel (OP1), as well as the wiring to the related rear-panel connectors, a useful reference for remote-only versions as well.

In the remote-only option, the rear-panel BCD FREQUENCY PROGRAM connector is wired directly to the various digit oscillators. In the local-control options, the rear wafers of all the panel switches are ganged to a single REMOTE/LOCAL control. The 4 control wires for each decade (3 for 100 MHz decade) pass through these rear wafers to either the rear-panel connector on REMOTE or the front wafers driven by the front-panel controls, on LOCAL. When the selector switch is in the REMOTE position, a contact closure to a red warning light labled REMOTE or SEARCH is made, showing that the frequency displayed on the dials is not necessarily that being generated by the synthesizers.

When that selector switch is on LOCAL, the control is by front-panel switches. The switches, except for the most significant (100 & 10-MHz steps), have no stops, are settable through 10 positions, and provide 8-4-2-1 BCD output corresponding to the decimally displayed numerals on the associated dials. The two most significant digit selecting switches are mechanically and electrically interlocked to decimally display the correct frequency while providing all sixteen states on the 4 binary control wires to 10 MHz per step decade.

On remote-only-option instruments, or local-control instruments set for REMOTE, the frequency of the 1-MHz, 100-kHz and 10-kHz decades can be continuously varied by a d-c voltage applied at one or both of the rear-panel SWEEP-IN connectors. With standard resolution options this capability is also available on all lower decades installed. This mode is enabled by programming 8 + 2 on the BCD control wires to the decade to be controlled.

In local-control-option instruments, a series of panel pushbuttons labeled OFF, X1 MHz, X100 kHz, X10 kHz, X1 kHz, X100 Hz, X10 Hz, X1 Hx and X0.1 Hz, permit this selection to be made with the frequency control on LOCAL. When any of these buttons, other than OFF, are depressed the red REMOTE/SEARCH panel warning light is illuminated to show that the digital frequency displayed is not necessarily that being generated by the synthesizer. A continuously adjustable MULTIPLIER on the panel, calibrated from −1 to +10 (plus a FINE ADJUSTMENT) is also provided. These controls can be used in a summing fashion, with control voltages applied at the rear inputs, or

their effect eliminated by turning the MULTIPLIER to the REMOTE ONLY position.

In instruments with less than full resolution, the ineffective frequency-control knobs and the ineffective frequency-search pushbuttons are disabled by mechanical locks. If additional resolution is installed at a later date, the appropriate locks can be readily removed.

In remote-only options, the OUTPUT level is controlled by a d-c voltage applied at the rear LEVEL PROG IN connector. In local-control options the OUTPUT level can be set by a panel control calibrated from 0 to +20 dBm, or this control can be set to its REMOTE position for external control as above.

The OUTPUT connector is arranged to be mounted on the rear panel of remote-only instruments or on either the front or rear panels of local-control options; a panel filler plug fills the vacant position.

4.3.2 3-MHz Digit Oscillator (Figures 6-9 and 6-10)

Section EU and EV are identical, except that EU provides the 10-kHz steps and EV the 100-kHz steps in the instrument. The plug-in etched-circuit board is the 1169-4044 Digit Oscillator Board (ED). A sweep-enable circuit, 1169-4024 board (SSE), is part of the enclosure base assembly.

The ED board produces a 3- to 3.9-MHz output in 100-kHz steps. The actual frequency of the oscillator on this board is 30 to 39 MHz, which is phase locked in 1-MHz steps to the 1-MHz reference input. The output from the oscillator splits into two paths. One path goes through a loop buffer to a diode sampling gate feeding a d-c amplifier, with an appropriate lead-lag filter, to form the phase-lock loop back to the dual varactor diodes. The other path goes through a divider buffer, divide-by-10 frequency divider and low-pass filter to the output on terminal 27.

The 1-MHz reference input on terminal 3 is processed by a temperature compensated current-switch limiter and pulse-forming circuit that produces a well-defined triangular sampling pulse. The pulse duration is chosen to minimize response to noise components outside the required frequency range of the lock loop.

Oscillator 10-step frequency selection is derived from the 8-4-2-1 binary-coded-decimal input by means of an intergrated circuit decoder, U3, following an intergrated circuit inverter, U2. Each of the 10 outputs of the decoder selects a different resistor in a precision voltage divider, at the input to the oscillator varactor diodes. This programs the oscillator nominally to within 40 kHz (4 kHz at the output terminal) for each frequency step.

The d-c voltage supplied to the voltage divider is controlled over a limited range by the phase error between the sampling pulse and the oscillator voltage, which causes the frequency to be pulled in and locked to the selected 30 to 39th multiple of the reference. The range of control voltage available is chosen to maintain lock over as wide a frequency error range as possible without the possibility of lock to an incorrect multiple. This provides the maximum correction for oscillator drift and tracking errors.

An inherent characteristic of the varactor diodes is their nonlinear frequency-control characteristic for the range required. A feature of the control system used is that it compensates for this characteristic with the switched voltage divider, so that the lock-loop gain is kept very nearly constant for all frequency steps, permitting an optimum trade-off between switching speed and stability margin.

There are only 4 set-up adjustments on the oscillator and lock circuits for the 10 frequency steps. The varactor control characteristics, though quite nonlinear, are very repeatable between assemblies. This permits the use of the precision resistor network in the programmer, with only minor trimming adjustments on the various board assemblies to bring the characteristics within satisfactory agreement. The major temperature characteristic of the varactors is compensated by a silicon diode, CR4, in series with the applied bias. C8 and C9 are negative-temperature-coefficient capacitors that correct for the remaining temperature characteristics of the oscillator.

The oscillator adjustment C11 permits setting the ratio of maximum-to-minimum frequency, and with L4 permits 2-point alignment with the usual interaction of such frequency adjustments.

R30 is a varactor-bias adjustment and, by the nature of the varactor control characteristics, permits the sag or deviation from the desired characteristic to be adjusted in the center of the frequency range. This, of course, interacts with the other adjustments, so that all adjustments are most readily made by repetatively step scanning the oscillator through its range, by an automatic programmer, and observing the error voltage in the lock loop at TP1 (terminal 18) with an oscilloscope.

R54 is the fourth set-up adjustment and is used mainly to compensate for d-c offsets in the sampler and d-c amplifier. This permits the establishment of a precise level on input terminal 29 for sweep-mode operation.

The sweep mode is enabled by programming 8 + 2 on the BCD input. The intergrated circuit, U1 on the SSE board, senses the presence of this command and opens the +5.6-V supply to the pulse generator on the ED board, by means of switch transistor Q1 and, at the same time, a negative current source, Q3, is turned on via inverter-switch transistor Q2. The current source forward biases switch diodes CR1 and CR2, between the external sweep input at C2 and ED board terminal 29. Except for small difference due to different currents in CR1 and CR2, the voltage applied at terminal 29 is equal to that applied at C2, with temperature characteristics of the diode drops compensated.

With no 5.6-V supply, the sampling pulse is not generated and the dc amplifier on the ED board goes into a saturated positive output condition, due to normal input

offset permitted by the diodes in the undriven sampler. At the same time, the one-of-ten decoder is receiving an illegal command (8 + 2), which opens the circuit to all controlled resistors in the precision voltage divider. This permits the remaining resistors to supply a maximum d-c voltage to the oscillator varactors, which would set the frequency well above its normal range, if not restrained by the voltage at terminal 29.

Actually, the negative current available from the current generator on the SSE board is more than sufficient to pull the oscillator frequency well below its lower limit, if it were not for the fact that the part of this current comes from the external source at C2, via CR2 on the SSE board. As previously noted, the voltage at terminal 29 is essentially that applied to C2 and search/sweep can be applied from an external source. When 8 + 2 is not present on the BCD control line, normal operation is restored and CR1 and CR2 on the SSE board are heavily back biased by R9, isolating both the output and input of the switch.

A common external source drives the C2 connections to all oscillators in the instrument, in parallel with the selection of the decade to be searched entirely by a 2 + 8 input command on its frequency-control lines.

4.3.3 EW, 30-MHz Digit Oscillator Sampler (Figure 6-11)

Section EW carries the 1169-4094 board (EWA) with the reference pulse generator, sampler, and high-level r-f loop amplifier for the 30-MHz digit oscillator. The circuits on this board are similar to those described for the EU and EV sections, except they operate at considerably higher levels. The reason for the higher levels is to keep the phase-noise contribution of this digit oscillator within acceptable limits at the output of the synthesizer. (The oscillator for the next lower digit is followed by a divide-by-10 frequency divider and consequently could have 20-dB higher phase noise for an equivalent contribution to the over-all noise of the instrument). The reason for the separate enclosure for this part of the circuit stems from the requirement of keeping spurious contributions low, with the higher sampler level, without the help of frequency division following the oscillator.

The 1-MHz reference pulse generator is quite similar to that described for sections EU and EV, except that an additional amplifier stage, Q7, is added at the output to produce the high-level pulse needed to drive the reverse-biased-diode sampling bridge. The 1-MHz REF input enters at terminal 31. The 5.6-V supply to the pulse generator at terminal 33 is switched off by an SSE board in Section EX, when the sweep mode is enabled, to disable the phase-lock loop as described for Section EU and EV.

The sampling-diode bridge is reverse biased by plus and minus 2 V, developed across R22 and R21 by current from the +18-V and −12-V supplies. Multiple bypass capacitors in the feed networks isolate the power supplies from the high-level signals on the bridge.

The r-f OSC SAMP enters at terminal 7 and is amplified by a 2-stage grounded-base isolating-and-limiting amplifier, consisting of Q8 and Q9, to a level of 8 dBm into R45, at the input to the sampling bridge. The output from the sampler is stored in C9 and in the coaxial line to, and a terminating capacitor in section EX. R24 is a high-frequency source termination for the coaxial cable to eliminate multiple reflections.

The OSC CONT output to the connecting coaxial cable to Section EX leaves the board at terminal 9.

4.3.4 EX, 30-MHz Digit Oscillator (Figure 6-12)

Section EX carries the 1169-4096 board (EXA) with the 30-MHz digit oscillator, Q1, associated buffers, BCD integrated-circuit inverter and decoder (with precision resistor network programmer), and the phase-lock dc amplifier. The description given for the 3-MHz Digit Oscillator in Section EU and EV is applicable here, except that the oscillator circuit is modified to operate at a higher level in the interest of low phase noise and a portion of the lock circuit is in Section EW. Also, there are 2 tuned traps between the d-c amplifier and the varactor at 1 MHz and 2 MHz, to null out spurious sideband components at these frequencies. The oscillator has the same trimming adjustments as described for Section EU and EV. There is an additional TEMP COMP adjustment that is normally set to the center of its range. This is an adjustment on the contribution of the silicon diode drop in the bias feed to the varactors and it is used to center the capture range of the oscillator at temperature extremes.

The output of oscillator transistor Q1 is taken from its emitter by an isolating emitter follower, Q2, driving 2 separate common emitter amplifiers, Q3, and Q4, in parallel. Q4 supplies the OSC SAMP output at terminal 3, via an LC matching network. Q3 supplies the 30- to 39-MHz OUTPUT at terminal 27, via an LC matching network, low-pass filter and a fixed resistive attenuator. C11 sets the tilt of frequency response, over the required range, for maximum flatness. As described for the other digit oscillators, R27 compensates for d-c offsets in the sampler and d-c amplifier to standardize the input required at terminal 29 when the oscillator is in the sweep mode. The 1169-4024 SSE board, shown in outline form in Figure 6-12, is shown in detail in Figure 6-10 and functions in this oscillator exactly as described in Section EU and EV.

4.3.5. GX, 500-MHz Digit Oscillator Sampler (Figure 6-13)

Section GX carries the 1169-4014 board (GD) with the reference pulse generator, diode-sampling bridge, 70-MHz harmonic amplifier, d-c amplifier with linearizing network, and a switched lock-loop filter. The 10-MHz INPUT sine-wave enters the board at terminal 36 and drives a step-

recovery-diode pulse generator, CR14. R65 permits setting the drive level for best signal-to-noise performance. A shorted delay line determines the pulse duration. A portion of the pulse signal is fed to the 70-MHz amplifier via R53, which delivers the selected 70-MHz component to terminal 42. L1 and L5 are peaking adjustments but are offset as required to set the desired level at terminal 42.

The major portion of the pulse signal drives the diode bridge to produce a short sample of the digit-oscillator voltage received at terminal 39 from Section-GY. This sample is held by C15 (plus the input capacitance of the d-c amplifier) completing a sample-and-hold phase detector. The diode sampling bridge is split into 2 capacitively coupled parts to permit the DC PROGRAM INPUT from terminal 33 to be added to the voltage produced by the phase detector. The short samples of the r-f waveform are readily transferred through the small coupling capacitors to combine with the program voltage at the input to the amplifier. R50 is a balancing adjustment for nulling out 10-MHz sampling-pulse components in the control system.

The d-c amplifier employs a multiple diode nonlinear feedback network to compensate for the nonlinear control characteristics of the varactor diodes in Section GY. There are several adjustments for setting the transfer characteristics of the d-c amplifier to produce a linear over-all frequency-control system. The effects of the adjustments are cumulative for low to high frequencies and somewhat interacting. R44 adjusts current source Q11, to set the minimum bias on the varactor in Section GY. R36 adjusts another current source, Q10 at the input to the d-c amplifier, to provide its input bias to minimize input ripple from the sampling process. R19 adjusts current source Q5, which provides the break-point bias for CR7 and CR8 in the linearizing network. R24 adjusts the difference in break voltages for CR7 and CR8. The last break point, for CR6, is set by R17. All these adjustments are most readily made in an automatically scanned test system and must be made for a particular oscillator board to be used in the GY section of the synthesizer. For this reason, factory adjusted replacement boards are supplied in pairs.

A switched lock-loop filter at the output of the d-c amplifier completes the circuits in this Section. The filter consists of R16 and C7 in the OSC CONTROL OUTPUT line to terminal 15. The lock-loop filter actuator forward biases CR5, when there is no beat signal present on the input to the filter, completing the circuit from C7 to ground and cutting off the high-frequency response of the loop. This permits the loop bandwidth to remain wide until phase capture is achieved but is made narrow thereafter to minimize phase-noise sidebands on the oscillator. Q1 and Q2 are beat-frequency amplifiers driving beat rectifier CR1 and CR2 to cut off switch-diode driver Q3, when a beat signal is present in the loop. CR16 and CR17 at the input to this system prevent overload of the amplifier in the interest of minimizing recovery time for fast switching.

4.3.6 Section GY, 500-MHz Digit Oscillator. (Figure 6-14)

Section GY carries the 1169-4016 board (GE) with the 500- to 350-MHz digit oscillator and associated buffer amplifiers for its phase-lock loop and main output, and a BCD d-c step programmer. The oscillator consists of oscillator transistor, Q3, with tuning inductor L4, and series-connected varactor diodes CR1 and CR2. The OSC CONTROL INPUT enters at terminal 31 from Section GX and is fed to the midpoint of the varactors through an r-f-isolating resistor and choke. L4 is initially adjusted for standardized varactor-tuning characteristics, with final linearizing and trimming adjustments made in Section GX.

The lock-loop buffer amplifier consists of 3 cascaded common-emitter stages using transistors Q4, Q5, and Q6. The output from this buffer to Section GX leaves at terminal 14. The buffer in the main output to terminal 44 is similar but only 2 stages are used, Q1 and Q2. R75 sets the output level at terminal 44.

The 4-bit binary d-c programmer receives its program inputs at terminals 1, 3, 5 and 7 for the 8, 4, 2, and 1 weights, respectively. Q7, Q8, Q9 and Q10 are inverting switch transistors, with their emitters biased to +2.3 V, for compatibility with external TTL control. These transistors drive transistor switches, Q11 – Q14, which select emitter resistors for current-source transistor Q16. The resistors are adjusted to provide currents with weights corresponding to the input commands. The effects of the separate switches are cumulative, so that 16 uniform voltage steps are provided at terminal 17 for the DC PROGRAM OUTPUT to Section GX. The characteristics of the over-all system are such that 3.75 V programs 500 MHz and each –0.25 V increments a 10-MHz lower frequency, down to 350 MHz. R52 sets the current source to produce the required drop across R54 to make 3.75 V at the output, with no program input commands. R43 is set to produce a –0.25 V output change when a binary 1 is programmed (voltage on terminal 7 lowered). R44 is set to produce a –0.50-V output change, when a binary 2 is programmed (voltage on terminal 5 lowered). R45 is set to produce a –1.00 V output change when a binary 4 is programmed (voltage on terminal 3 lowered) and R46 is set to produce a –2.00 V output change when a binary 8 is programmed (voltage on terminal 1 lowered). Section GX combines the error voltage from its phase detector with the DC PROGRAM OUTPUT to phase-lock the oscillator at the selected 10-MHz step in the 500- to 350-MHz range.

4.3.7 Section H, Fine Resolution (Figures 6-15 – 6-18)

Section H is identified in the synthesizer as the FINE RESOLUTION SECTION, silk screened on its cover plate. This section is utilized only for the increased-resolution instruments, OP4A through OP4G. The required circuit-board configurations for the various resolution options are silk screened on the cover plate. In instruments with no resolution options, this section is bypassed in the chassis

wiring and no mother board is installed. Different mother boards are used, 1169-4090 (Figure 6-15), for the standard resolution options, OP4A through OP4E, and 1169-4092 (Figure 6-16) for the economy resolution options, OP4F and OP4G. If less than the maximum resolution is originally installed with either mother board, it can easily be increased at a later date by removal of one or more plug-in bridging boards and installing the appropriate mixer/divider and digit-oscillator boards. To change or add mother boards requires a factory modification.

The standard-resolution mother board, 1169-4090, carries 5 sweep-enable circuits, described in Sections EU and EV, as well as the sockets to receive up to 5 mixer/divider boards and 5 digit-oscillator boards. The 1169-4044 digit-oscillator board, Figure 6-9, has already been described in Sections EU and EX. The 1169-4065 mixer/divider board is electrically identical to the 1169-4060 mixer/divider board, Figure 6-19, described in para. 4.3.8, Section J. The 1169-4080 bridging board replaces the 1169-4065 mixer/divider board in all its unoccupied stations to provide the 5-MHz input to the first active station, and loads the 42-MHz reference bus, similarly to the 1169-4065 board, to maintain the desired level. The unoccupied digit-oscillator stations are left vacant.

The economy-resolution mother board, 1169-4092, carries a divide-by-10 intergrated-circuit frequency divider, U1, driven by buffer transistor Q1 from the 1 MHz INPUT. This provides the 100-Hz reference required for the one or two dual-decade "scale-of-n" digit oscillators used in options 4F and 4G, respectively. Each of these oscillators is carried on two plug-in boards, so that two stations for each are built in on the mother board. One or two 1169-4065 (JA) mixer/divider boards are used depending on the resolution option, and appropriate stations are furnished on the mother board. A station is also provided for an additional but different mixer/divider board, 1169-4025 (JBA), used in the 1-Hz resolution option, OP4G. For the 100-Hz option, (OP4F), 1169-4080, bridging is required in this station only.

The 1169-4025 (JBA) board (Figure 6-17) carries a balanced mixer, Q4 and Q5, for adding the 5 to 5.1 balanced input at terminals 43 and 44 to a fixed 45-MHz signal. This mixer is followed by a 10-to-1 frequency divider, U1/Q6/U2, feeding the 5 to 5.01 MHz resulting signal to the output at terminal 27, via a tuned filter circuit. The fixed 45-MHz signal is obtained from cascaded triplers also on the board, consisting of Q2 and Q3, driven by a buffer amplifier Q1 with the 5-MHz input from terminal 3. The 50- to 51-MHz bandpass filter at the output of the mixer is adjusted by C21 and L7. L6 is a balance adjustment. The 5- to 5.01-MHz output tuned circuit is peaked by C31. The first tripler is peaked by C6 and C10 and the second tripler by L4 and L5.

The 1169-4065 (JC) board, with a fixed 5-MHz input, takes the 3.00 to 3.99 MHz output of the dual-decade digit oscillator for the 1- and 10-Hz steps and translates it to 5.000 to 5.099 MHz, in 1-kHz steps. See para. 4.3.8 for a detailed description of the circuit used for this process. A balanced output from the JC board drives the JBA board described above, to produce a 5.0000- to 5.0099-MHz output in 100-Hz steps at its output. This feeds another JC board, which combines the 3.00 to 3.99 MHz output of another dual-decade digit oscillator, for the 100- and 1-kHz steps and produces a 5.00000 to 5.09999 MHz signal in 10-Hz steps at the output of the mother board. A later 10-to-1 frequency division in the synthesizer makes these 1-Hz steps at the output. For 100-Hz resolution only, one 1169-4065 (JC) board and one set of dual-decade digit-oscillator boards are used, with an 1169-4080 bridging board, in the 1169-4025 (JBA) station.

The dual-decade "scale-of-n" digit oscillators are carried by the 1169-4021 board (DA) and the 1169-4023 board (DB), shown schematically in Figure 6-18. The output frequency of this oscillator covers 3.00 to 3.99 MHz in 10-kHz steps. The reference input at 100 kHz, at terminal DB106 from the divider on the mother board, is divided by 10 again, by U3 and U14 on the DB board, to produce a 10-kHz OUTPUT REF at terminal DB25, which enters the DA board at terminal DA44. This input drives a ramp generator using transistors Q1 – Q5.

The circuit generates a nonlinear ramp, which compensates for gain variations in the phase-lock loop, due to the nonlinear control characteristics of the variable-capacitance diode (C22) and due to the variation in the division ratio of the scale-of-n divider. The total slope variation of the ramp, from the low voltage to the high voltage end, is approximately 1 to 4. The ramp starts at essentially 0 V and has a peak amplitude of 10 V, set by R-17. This voltage appears across C5. C5 is discharged by the amplified 10-kHz INPUT REF pulse, and the start of the ramp is accurately timed by the trailing edge of this pulse.

The phase-lock control voltage for the oscillator is produced by sampling the reference ramp with the 10-kHz O/N-input from the DB board. This input is a pulse of 0.4 μs duration and connects C6 to the ramp generator by opening the sampling gate for this duration. Since C6 is connected to the very high input impedance of the filter/amplifier, and since the sampling gate has extremely low leakage when closed, the voltage obtained during one sampling interval is retained with very little ramp off until the next sample is obtained, 0.1 ms later. The d-c voltage gain of the filter amplifier is unity, so the voltage on C6 is the voltage applied to C22. The control action of this circuit will cause the frequency of the oscillator to be changed until the ramp is repetitively sampled, at exactly the right time, to produce the required control voltage. The filter/amplifier has an RC filter at its input, with feedback to a capacitor, to produce a sharp cut-off characteristic. There is a passive single-pole RC filter between this amplifier and C22. Both of these filters are bypassed by back-to-back diodes to minimize time for oscillator lock-up, when

the programmed frequency is changed. The purpose of the filtering is to minimize sidebands at the 10 kHz sampling rate, and to limit the frequency range of noise sidebands produced by the reference input.

The oscillator and r-f amplifier use dual-insulated-gate, field-effect transistors to minimize loading on the relatively high impedance L-C frequency-determining circuit (consisting principally of the variable capacitance diode and inductor L1). The oscillator amplitude is set by C13. The pulse output to drive the scale-of-n divider, on board DB, is obtained by resistance coupling from the drain circuit of the oscillator transistor and a 2-stage amplifier.

The divider consists of two identical programmable decades (U9/U10), followed by dual flip-flop U6 and a number of gates to program and reset the dividers to produce division by 300 to 399. Operation is continuous since reset is completed between input pulses. To minimize effects of propogation time and to simplify the programming of each decade, the coding system summarized in Table 4-1 is used. Note that two recognition states are used, with the decade reset to the complement of these states, to produce the required division ratio. For relation to the schematic and to points on the circuit board, note that IC output A, B, C, and D correspond to IC terminal numbers 5, 9, 2, and 12 respectively.

The programmable decades operate as any decade divider, except that when a reset pulse occurs, the data input derived from the program lines is strobed into the decade. The reset pulse occurs when, and only when, the coded output for the selected digit numbers occur at all decades, and the dual flip-flops have accumulated a count of 3.

Individual diodes, as well as integrated-circuit gates, are used in the system. A careful study of Figures 6-18 and 4-1, and Table 4-1, will reveal that recognition of the last bit of coded information, to initiate a reset pulse, occurs in the very first flip-flop in the first decade, with all other gates open and waiting. The recognition pulse triggers a reset-pulse generator, which increases the duration of the pulse sufficiently to override the memory of pre-existing states in all decades. This pulse is negative going, and in the case of the decades, strobes in the coded data set by the control lines. The same pulse resets the dual flip-flops to zero. At the end of the reset pulse, the divider is immediately ready for another clock pulse. Since the duration of the reset pulse is less than the interval between clock pulses, not a single input pulse is lost and the divider functions continuously as required. A somewhat longer duration strobe pulse is required for best operation of the sampled phase detector (DA board) so an additional pulse generator is used to produce the O/N output of the DB board.

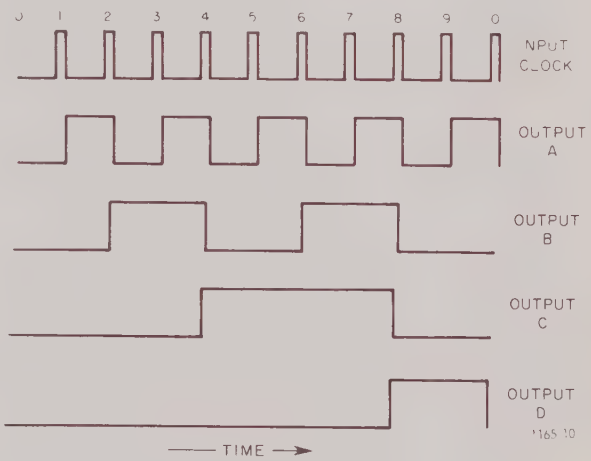


Figure 4-1. Timing diagram for divider circuits U3, U9 and U10 on the program board (DB).

Table 4-1

PROGRAM CODING OF DECADES IN SCALE OF N DIVIDER

Decimal Program	Binary State Program				Reset				Recognize			
	A	B	C	D	A	B	C	D	A	B	C	D
0	0	0	0	0	1	0	1	0	1	0	1	0
1	1	0	0	0	0	0	1	0	1	0	1	0
2	0	1	0	0	1	1	0	0	1	0	1	0
3	1	1	0	0	0	1	1	0	1	0	0	1
4	0	0	1	0	1	0	1	0	1	0	0	1
5	1	0	1	0	0	0	1	0	1	0	0	1
6	0	1	1	0	1	1	0	0	1	0	0	1
7	1	1	1	0	0	1	0	0	1	0	0	1
8	0	0	0	1	1	0	0	0	1	0	0	1
9	1	0	0	1	0	0	0	0	1	0	0	1

4.3.8 Section J, 5.1 MHz Intermed. Mix/Div. (Figure 6-19).

Section J carries the 1169-4060 board (JA). The 1169-4065 (JC) board, used in the Fine Resolution Section, is identical electrically with the JA board, the difference being that it has lower sectional shields without attached grounding springs.

The JA board combines a 5- to 5.1-MHz input signal, carrying all lower-decade frequency information with the frequency of its associated 3-MHz digit oscillator, and delivers a signal with a frequency in the same 5- to 5.1-MHz range to subsequent decades. The combination forms a complete digit insertion-unit. Such units can be cascaded indefinitely to produce a decimally related series of frequency digits as outlined in para. 4.2.

The 5.0 to 5.1 MHz INPUT enters the board at terminal 41 and is fed to input mixer Q1 by a fixed-tuned transformer. A 42 MHz INPUT from Terminal 43 is amplified by Q2 and coupled by a tuned transformer (set by L2) to the input mixer, resulting in an up-converted 47 to 47.1 MHz output. This signal goes through a bandpass filter, adjusted by L3 and L4, to a 47-MHz amplifier, Q3. The output of Q3 passes through a tuned circuit peaked by L5 and forms the in-phase input to a balanced transistor mixer, Q3 and Q5. The 3 to 4 MHz INPUT from the associated digit oscillator enters the board at terminal 19 and generates the push-pull input to the mixer, by means of balancing transformer T2. The up-converted push-pull 50 to 51 MHz output is coupled by a double-tuned circuit to the following frequency divider. The trimming adjustments for this circuit are C16 and L7, with L6 affording a balancing adjustment.

The frequency divider consists of U1 and U2 coupled by driver Q6, producing an over-all division-by-10. The resulting 5.0- to 5.1-MHz signal is filtered by a tuned-output transformer, adjusted by C26, and fed to terminals 2 and 3. Terminal 2 is normally grounded but is used in one application of a JC board, with terminal 3, to provide a balanced output.

4.3.9 Section L, 47-MHz Intermediate Mixer (Figure 6-20).

Section L carries the 1165-4018 board (LA). It combines a 5- to 5.1-MHz input signal, carrying all 10-kHz steps and lower decade-frequency information with a fixed 42-MHz input to produce an up-converted 47- to 47.1-MHz output.

The 5.0 to 5.1 MHz INPUT enters the board at terminal 16 and is fed to the mixer, Q1, by a fixed-tuned transformer. A 42-MHz input from terminal 18 is amplified by Q2 and coupled by a tuned transformer (set by L2) to the mixer, providing an up-converted 47 to 47.1 MHz output. This signal goes through a bandpass filter, adjusted by L3 and L4, to 47-MHz amplifier Q3. The output of Q3 passes through a double-tuned circuit to the 47 to 47.1 MHz OUTPUT at terminal 3. Adjustments for this circuit are L5 and L6. R12, in the emitter circuit of Q3, sets the output level.

4.3.10 51-MHz Intermeidate Mixer. (Figure 6-21).

Section MT carries the 1169-4062 board (MB), which combines the 47 to 47.1 signal from Section L, with decade frequency steps of 10 kHz and smaller, with the 3 to 3.9 MHz in 100-kHz steps from the associated digit oscillator, to produce a 50- to 51-MHz output.

The 3- to 4-MHz digit-oscillator signal enters the board at terminal 18 and is attenuated in a fixed resistive pad and applied to one input of a double-balanced mixer, U1. The 47 to 47.1 MHz INPUT at terminal 16 feeds the other input port of the mixer. The resulting output is amplified by Q1, followed by a triple-tuned filter for the up-converted 50- to 51-MHz output. C5, C8 and C10 are used to adjust this filter. The output leaves the board at Terminal 3.

4.3.11 Section MO, Master Oscillator. (Figures 6-22/23)

Section MO uses moderate stability plug-in master oscillator (1169-4031) for option 2A or an 1169-4033 High Stability plug-in master oscillator (MO-10B) for option 2B. The MO-10C furnishes a 5-MHz output, the MO-10B a 10-MHz output to Section RP, via terminal 4 when the INT, EXT. REF rear-panel switch is set to INT position. When this switch is set to EXT position, the drive must be supplied at the EXT REF INPUT rear-panel connector and the power supply to the master oscillator is turned off. EXT REF INPUT must be used when no master oscillator is installed. Both master oscillators can be controlled over a limited frequency range by a variation of d-c voltage at the DC FREQ CONTROL connector, which is applied to the oscillator via terminal 10. The nominal +8 V bias at this terminal is supplied at terminal 9, which is normally wired to terminal 10 by an internal jumper. The source resistance of the bias supply is 900 ohms, so it can easily be overridden by the external control source eliminating the need for any switching or removal of the jumper. A rear-panel pin jack permits the use of an external BAT for maintaining the oven temperature of the high-stability master oscillator during power interruptions. This input is supplied to the oscillator via terminal 8, with internal diodes CR1 and CR2 automatically transferring power sources for this operation.

4.3.12 Section OA, 160-MHz Output Amp(Figures 6-24/25)

Section OA carries two boards, the 1169-4002 (OAA) and the 1169-4004 (OAB). The OAA board carries the low-level variable-gain amplifier for the 0.4- to 160-MHz output, as well as the 0- to 10-MHz fixed-low-level output amplifier. The 0- to 160-MHz output from the UHF Section enters the board at terminal 41. The main output signal is amplified by Q1, goes through 2 variable-gain FET amplifiers, Q2 and Q3, and is further amplified by Q4 and Q5. Q6 is an output emitter follower to the OAB board, via

terminal 3. U1 and Q7 comprise the 0- to 10-MHz amplifier, supplying output via terminal 44 to the 0- to 10-MHz rear-panel output connector. R49 is the d-c zero adjustment and R53 is the level-setting adjustment for this output. The ALC input from the detectors and amplifier systems on the OAB board enters the OAA board at terminal 24.

The OAB board carries the high-level driver and output-amplifier stages for the 0.4- to 160-MHz main output plus a peak-to-peak output rectifier and ALC amplifier system. The input enters at terminal 43 and is amplified by a complementary transistor driver, Q1/Q2, followed by a complementary transistor output stage, consisting of Q3 and Q4. The output is fed through a 50-ohm source resistor, R22, via terminal 26 to the main output connector. The voltage ahead of the 50-ohm source resistor is monitored by a peak-to-peak rectifier consisting of CR1 and CR2. The diodes are forward biased from the +18-V and −12-V power supplies, by R42 and R65. One-half of U1 and Q5 comprise a d-c amplifier whose gain is such that the dc voltage applied to pin 7 of U1 is exactly twice the rms output voltage. R28 is a zero adjustment for this amplifier but is offset slightly to maintain the 2:1 voltage relationship at 0.1 maximum output voltage, with R43 setting it at full output. This gives excellent tracking over a 20-dB output range. CR3 through CR9 provide temperature compensation for the rectifier diodes. The second half of U1 is used on a voltage comparator, between the input on pin 7 and the LEVEL SET input applied to pin 4. The error voltage is further amplified by Q6 and supplies the ALC output to the OAA board at terminal 22 by emitter follower Q7. The over-all ALC system acts to make the input to pin 7 match the voltage on terminal 2, consequently the r-f output into 50-ohm is very nearly equal to one-half the LEVEL SET input. R57 is a loop-stability adjustment set for best step response of the system.

4.3.13 Section P, Phase Modulator. (Figures 6-26 -- 6-28)

Section P carries two boards. One of these boards can be either the 1169-4012 70-MHz amplifier board (PD) or the 1169-4008 Phase Modulator board (PC). The PD board is used when no phase-modulation capability is included and the PC board is used for the optional phase-modulation capability, OP3. The other board is the 1165-4022 420 MHz board (PB).

The 1169-4012 board (PD) receives a 70-MHz input from Section GX, via Terminal 2, filters and amplifies this signal, and delivers a 70-MHz signal to the PB board, via terminal 26. The PD board carries an input resistive attenuator, 3-pole bandpass filter, and output amplifier Q1. L1 — L3 adjusts the bandpass filter; L4 peaks the output amplifier.

The optional 1169-4008 board (PC) receives a 70-MHz input from Section GX via terminal 2, filters, amplifies, inserts phase modulation (applied via terminal 22), and delivers the phase-modulated 70-MHz signal to the PB board, via terminal 26. The PC board carries an input resistive attenuator, 3-pole bandpass filter, buffer amplifier, Q1, linearized phase modulator with varactors, CR1 and CR2, FET buffer amplifier Q2, output amplifier, Q3, and a direct-coupled modulation amplifier, Q4, Q5, and Q6. L1, L7, and L2 adjust the bandpass filter, L6 peaks the output amplifier, and R29 adjusts the sensitivity of the phase modulator.

The 1165-4022 board (PB) receives the 70-MHz input from the PD or PC board via terminal 2, multiplies the frequency by 3 and 2 and delivers a 420-MHz output, via terminal 23, to the UHF Section. The PB board carries tripler transistor Q1, a 210 MHz 2-pole bandpass filter, and output doubler transistor Q2. C4 and C6 adjust the bandpass filter and C7 peaks the doubler output circuit.

The enclosure base for Section P has a 70-MHz output, obtained from the 70-MHz input to terminal 2 of the PD or PC boards by a 12-pF coupling capacitor. This output, 6A, feeds the 70-MHz input to Section RD.

4.3.14 Section RB, Reference Buffer. (Figure 6-29)

Section RB carries the 1169-4048 Reference Buffer Board (RBA). This board receives a standardized 10-MHz input from Section RP, via terminal 5, delivers 10 MHz by 3 separately buffered outputs, to Section G via terminal 1, to Section RD via terminal 15, and to the 10-MHz OUT, rear-panel connector, via terminal 18. The RB board carries tuned-output buffer amplifier Q4, for terminal 1, intermediate-tuned buffer amplifier, Q3, and tuned output buffer amplifier Q1 and Q2 for terminals 18 and 15, respectively. C19 peaks output at terminal 1, C11 peaks the intermediate buffer, and C3 peaks output at terminal 18.

4.3.15 Section RD, Reference Divider. (Figure 6-30)

Section RD carries the 1169-4006 Reference Divider Board (RDA). This board receives 70 MHz from Section P, via terminal 2, and 10 MHz from Section RB, via terminal 9. The 70-MHz input is amplified by tuned buffer, Q1, then frequency divided-by-5 in U1 and U2, and the resulting 14-MHz signal delivered to Section RM, via a tuned transformer and terminal 5. The 10-MHz input feeds decade divider U3, which produces one 5-MHz and 3 separate 1-MHz outputs. The 5-MHz output is fed, via a low-pass filter and terminal 13, to Section J or Fine Resolution Section H. The 1-MHz rectangular-waveform outputs are fed to Section EW via terminal 19, Section EU via Terminal 15, and to Fine Resolution Section H via terminal 17. The 1 MHz OUT at the rear-panel connector is obtained from the last output by a series isolation resistor in Section H. C5 peaks the 70-MHz input to U1; C9 peaks the 14-MHz output from U2.

4.3.16 Section RM, Reference Multiplier. (Figure 6-31)

Section RM carries the 1169-4000 Reference Multiplier Board (RMA). This board receives a 14-MHz input from

Section RD, via terminal 15 and delivers a 42-MHz output, at terminals 15 and 18, to Sections J and H. It delivers an isolated 42-MHz output, at terminal 1 to Section L, and to the 42-MHz rear-output connector, via an additional series-resistor isolator in the chassis. A separate X3 frequency multiplier and output amplifier is used for the output at terminal 1, consisting of Q2 and Q1, respectively. Q3 is a common input buffer. The X3 frequency multiplier and output amplifier (for terminals 15 and 18) consist of Q4 and Q5. C5 peaks the output of Q2, C1 and C23 tune the double-pole filter at the output of Q1. C14 and C18 peak the outputs of Q4 and Q5, respectively.

4.3.17 Section RP, Reference Processor. (Figure 6-32)

Section RP carries the 1169-4046 Reference Processor Board (RPA). This board receives a 5- or 10-MHz signal from Section MO or EXT REF INPUT, with a wide range of levels, and delivers a filtered 10-MHz signal at a standardized level to Section RB. The input enters at terminal 18 and drives amplifier Q1 via a lightly forward-biased diode, CR1. CR1 distorts a 5-MHz drive signal to provide a 10-MHz component in the output of Q1. The output of Q1 is tuned to 10 MHz and CR1 and CR4 provide amplitude limiting. Q2 and Q3 furnish additional limiting by being alternatively switched by the 10-MHz signal from Q1. Q3 drives a 10-MHz double-pole bandpass filter with fixed current pulses, set by the value of the common-emitter resistor for Q2 and Q3. The output of the bandpass filter feeds amplifier Q4, which drives the 10-MHz monolythic crystal filter in the output to Section RB at terminal 2. L2 and L3 adjust the double-pole bandpass filter. R9 sets the output level to section RB.

4.3.18 Section SS, Search Sweep Driver. (Figure 6-33)

Section SS consists of the 1169-4022 Search/Sweep Driver Board (SSA) mounted near the panel of the instrument, at the lower left side. This is not a plug-in board but is permanently wired to the SWEEP IN connectors by semirigid coaxial cables. In manual option instruments, additional connections are wired into the panel controls. This section sums, without interaction between sources, the two rear inputs and the voltages from the panel controls and (from WT6) drives all the sweep-input terminals of oscillators in the synthesizer. The transfer characteristic is designed to compensate for the nonlinear control characteristics of the oscillators, so that a linear over-all sweep-input-voltage-to-frequency characteristic is obtained.

Separate discrete-component operational amplifiers (3) are used to meet the requirements for low noise, wide bandwidth, and large but limited output-voltage swings. The first operational amplifier consists of Q1 and Q2 and is used in the inverting mode to sum the 2 rear panel inputs, at WT8 and WT10, and the outputs of the front-panel controls when used.

The second operational amplifier, consisting of Q3 and Q5 is used to reinvert the control signal and add in some offset and temperature compensation emanating from Q4. Q10 is a limiting emitter follower used to prevent the output voltage from going below a minimum acceptable level for the digit oscillators. Precision resistors R7 and R8 set the limiting point.

The output operational amplifier, consisting of Q6, Q7 and Q8, is used in the noninverting mode and employs a nonlinear feedback network, composed of offset-biased diodes CR1, CR2, and CR3, and precision resistors. The temperature characteristics of the diodes is compensated by the temperature characteristic of bias-feed transistor, Q9. All precision resistors involved in the circuit are part of a precision thin-film network, Z1. R28 sets the offset bias at WT6 with zero sweep input voltage. R38 permits the break points of the diode network to be changed slightly for best match to a linear control characteristic. Q8 is mounted in a socket for easy replacement and acts like a fuse to protect the circuit from accidental short-circuits on its output terminals.

4.3.19 Section UHF. (Figures 6-34 – 6-37)

The UHF Section is mounted on the bottom of the instrument chassis and is the complete electro-mechanical assembly, 1169-4120, shown in Figure 6-34. This section combines the 50- to 51-MHz signal, with 100-kHz and smaller digit steps, from Section MT, with the 1-MHz/step 30- to 39-MHz signal from Section EX, and the 10-MHz/step signal from Section GY, to provide the 0 to 160 MHz input signal for section OA.

The UHF Section carries 3 built-in comb-line bandpass filters, a 3-pole for 420 MHz, a 4-pole for 470 MHz, and a 6-pole for 510 MHz. These filters are aligned at the factory, using swept-frequency techniques, and field alignment should not be required, unless the assembly has suffered physical damage, in which case the entire assembly should be replaced as a unit.

The remaining circuits in the assembly are carried by separate etched-circuit boards, screw mounted and hard wired into the assembly. The schematics for these circuits are shown in Figures 6-35, 6-36, and 6-37. All signal interconnections between the separate board assemblies are made with semirigid coaxial cables.

The 50- to 51-MHz signal from Section MT enters the UHF Section via P6 and a semirigid coaxial cable. It enters the 1169-4036 Intermediate Amplifier Board (IAC) at WT-1 and is amplified by a cascode-amplifier, using Q1 and Q2, then goes through a 3-pole bandpass filter to board output at WT-3. R7 is set to obtain a standardized level at

the output of the 470-MHz bandpass filter. C6, C9, and C11 adjust the 3-pole bandpass filter.

The 50- to 51-MHz signal from the IAC board enters the 1169-4098 Mixer Board (MXB) at terminal 1 and feeds the signal port of a double-balanced mixer, U1, after passing through a resistive attenuator. The "local-oscillator" input for this mixer comes from Section P via P7, a semirigid coaxial cable and the 420-MHz bandpass filter. J5 provides access to the filter output for test purposes. The 470- to 471-MHz output of MXB leaves the board at terminal 3 and goes to J2, at the input of the following Intermediate Amplifier, 1169-4026.

The 470- to 471-MHz signal from J2 feeds the 1169-4026 Intermediate Amplifier Board (IAB), where it is amplified by Q2 and Q1 and applied to the input of the 470-MHz bandpass filter. C6 and C9 are the peaking adjustments for the IAB board.

The input and output of the 470 MHz bandpass filter are accessible for test purposes by connectors J3 and J6

The 470- to 471-MHz output of the 470-MHz bandpass filters enters the 1169-4097 Mixer Board (MXA) at terminal 2 to provide the "local-oscillator" input to double-balanced mixer, U-1. The 30- to 39-MHz "signal" input to this mixer enters at terminal 1 via P1 from Section EX. The 500- to 510-MHz output goes via terminal 3, to the 510-MHz bandpass filter. The input and output of this filter are accessible for test purposes by connectors J4 and J7.

The 500- to 510-MHz output from the 510-MHz bandpass filter feeds the input of the 1169-4030 Intermediate Amplifier Board (IAA) via J1. The IAA board carries a 3-pole broadly tuned amplifier, Q1, Q2, and Q3, whose output leaves the UHF Section at J10. C14 and C13 adjust the frequency response of the amplifier.

The 500- to 350-MHz input to the UHF Section comes from Section GY by way of the 500- to 350-MHz rear panel IN and OUT connectors and enters at J8. This signal feeds the 1169-4077 Isolation Amplifier Board (IAD). The signal goes through a 10-dB input attenuator, is amplified by broadband amplifier Q1, and provides the 500 to 350 MHz output at WT3, after passing through a 3-dB attenuator. C1 adjusts the response for the flattest output over the frequency range.

The 500 to 350 MHz from the IAD board enters the 1169-4099 Mixer Board (MXC) at terminal 1 and provides the "signal" input for the double-balanced mixer, U1, after undergoing a 6-dB attenuation in a resistive padder. The 500 to 510 MHz "local oscillator" input (at terminal 2) for this mixer comes from J10, by way of the rear-panel 500- to 510-MHz IN and OUT connectors, and enters the UHF Section at J9. The resulting 0- to 160-MHz output leaves the board at terminal 3 and goes to the 1169-4020 Low--Pass Filter (LPA). This is an 11th order low-pass filter designed to reject the input signals as well as 3rd-order spurious mixer products. All inductors are created by the etched pattern of the board. The mounting of the board is arranged to provide the necessary shielding for minimizing signal leakage past the filter. The 0 to 160 MHz output signal from the filter leaves the UHF Section by a semirigid coaxial cable and goes to Section OA via P4.

4.3.20 Section V, Power Supply. (Figure 6-38)

Section V is the 1169-4110 Power Supply, which is a removable assembly in the synthesizer, carried by the upper portion of the rear panel. All electrical connections to the main body of the instrument are made by a plug attached to the main power cable. The mechanical mounting is by screws through the 2 side frame members of the chassis and by screws at the top-front of the assembly. The circuits in the synthesizer require separate power sources of −12 V, +5.6 V and +18 V, all from the single power supply assembly.

Circuits for the 1169-4110 Power Supply are carried by the 1169-4050 Rectifier Board (VA), mounted on the Power Transformer, and the 1169-4055 Regulator Board (VB), mounted on the heat-sink assembly with the series-pass power transistors. The heat sink and regulator board assembly is removable as a unit from the rear panel with a sufficiently long flexible interconnecting cable to permit operation in this extended condition for trouble-shooting access. An additional separation of the regulator board can be made for further accessibility.

The tapped power-transformer primary and associated selector switch permit selection of a wide range of operating voltages. The regulating circuits maintain constant supply voltages to the rest of the synthesizer, with line voltage variations of up to ±10% around the center of the selected range. All supply voltages are referenced to that of the −12-V supply, which uses an integrated-circuit regulator, U1. A separate series-pass transistor, Q2, mounted on the heat sink, is used for this supply. R13 and Q14 provide current-limiting sensing for the −12-V supply. The voltage-sensing leads for this supply, as well as the other two, are taken through the interconnecting plug to the load side, to eliminate the effect of contact resistance.

Q1, in the +5.6-V supply, compares the voltage developed at its output with that of the −12-V supply (by means of R5, R6 and R7) and supplies an error signal, which is amplified by Q3, Q4 and Q5, to control series-pass transistor Q1 on the heat sink. R1 and Q15 provide the current-limiting sensing to protect this supply against short-circuits.

Q7 in the +18-V supply compares the voltage developed at its output with that of the −12-V supply (by means of

R22, R23 and R24) and supplies an error signal amplified by Q9, Q10, and Q11 to control series-pass transistor Q4, via Q3 both on the heat sink. R19 and Q13 afford the current-limiting sensing to protect this supply against short-circuit. Boosted bias voltage for Q11 is provided by a separate rectifier system, using CR9, CR10, CR11 and CR12 on the rectifier board. A similar boosted bias for U1 in the −12-V regulator, filtered by R12 and C4, is provided by +5.6-V rectifier and the +18-V supply boosts bias for all the amplifier circuits in the +5.6-V regulator, via R30 and C14.

R15 and R16 are the coarse and fine voltage-setting adjustments for the −12-V supply. R6 is the adjustment for the +5.6-V supply and R23 is the adjustment for +18-V supply. These adjustments are accessible from the rear of the instrument by removing the cover plate of the transistor heat sink. The −12-V adjustment must be made first, then the 18-V adjustment, and finally the +5.6-V adjustment. Appropriately labeled pin jacks are available on the rear panel to check each of the supply voltages. No adjustment should be attempted, unless a monitoring voltmeter with accuracy of a few millivolts is used.

Service and Maintenance—Section 5

5.1 GR FIELD SERVICE 5-1
5.2 INSTRUMENT RETURN 5-1
5.3 MAJOR COMPONENTS 5-1
5.4 GENERAL MAINTENANCE 5-1
5.5 MINIMUM PERFORMANCE STANDARDS 5-5
5.6 TROUBLE ANALYSIS 5-7
5.7 OUTPUT ADJUSTMENTS 5-8
5.8 AUXILIARY OUTPUTS 5-8
5.9 PREVENTIVE MAINTENANCE 5-9
5.10 LUBRICATION 5-9

WARNING

Line voltage terminals are exposed when covers are removed. Exercise caution during trouble-shooting, adjustments, or repair.

5.1 GR FIELD SERVICE.

Our warranty attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please contact our Service Department (see last page), giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial, I.D., and type numbers of the instrument.

5.2 INSTRUMENT RETURN.

Before returning an instrument to General Radio for service, please contact our Service Department or nearest District Office, requesting a "Returned Material" number. Use of this number will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

5.3 MAJOR COMPONENTS.

Figures 5-1 and 5-2 identify the major components of the unit with their corresponding locations.

5.4 GENERAL MAINTENANCE.

5.4.1 Plug-In Etched Boards.

Detailed instructions are included in this manual to isolate a malfunction to a particular etched-circuit board or group of boards. Because of complexity and the difficulty in troubleshooting down to the detail-part level, it is strongly recommended that repairs be handled by replacement of the circuit board. For those who desire to troubleshoot to the detail-part level, information such as voltages and waveforms on the schematic drawings, parts lists, and the circuit description (in the theory section) are supplied.

NOTE

The following boards must be replaced in pairs. A single part number is provided for each pair.

1169-4094 30-MHz Digit Sampler Board (EWA) 1169-4096 30-MHz Digit Oscillator Board (EXA)	P/N 1169-4800
1169-4014 500-MHz Digit Sampler Board (GD) 1169-4016 500-MHz Digit Oscillator Board (GE)	P/N 1169-4802
1169-4002 Output Amplifier (OAA) 1169-4004 Output Amplifier (OAB)	P/N 1169-4804

In order to expedite the repair or replacement of the defective etched-circuit board(s) use the following procedure: Contact your nearest General Radio repair facility and supply them with the type, serial number, and identification (I.D.) number of the instrument, the part number of the defective board(s), and a purchase order number. The P.O. number allows for billing, if the unit is out of warranty, and for identification to expedite replacement. The repair facility will arrange for a replacement to be shipped as quickly as possible. Return the defective board(s) in the packing supplied with the replacement(s), or equivalent packing, to prevent further damage to the board(s). Please identify the part, with the "Returned Material" number on the tag furnished with the replace-

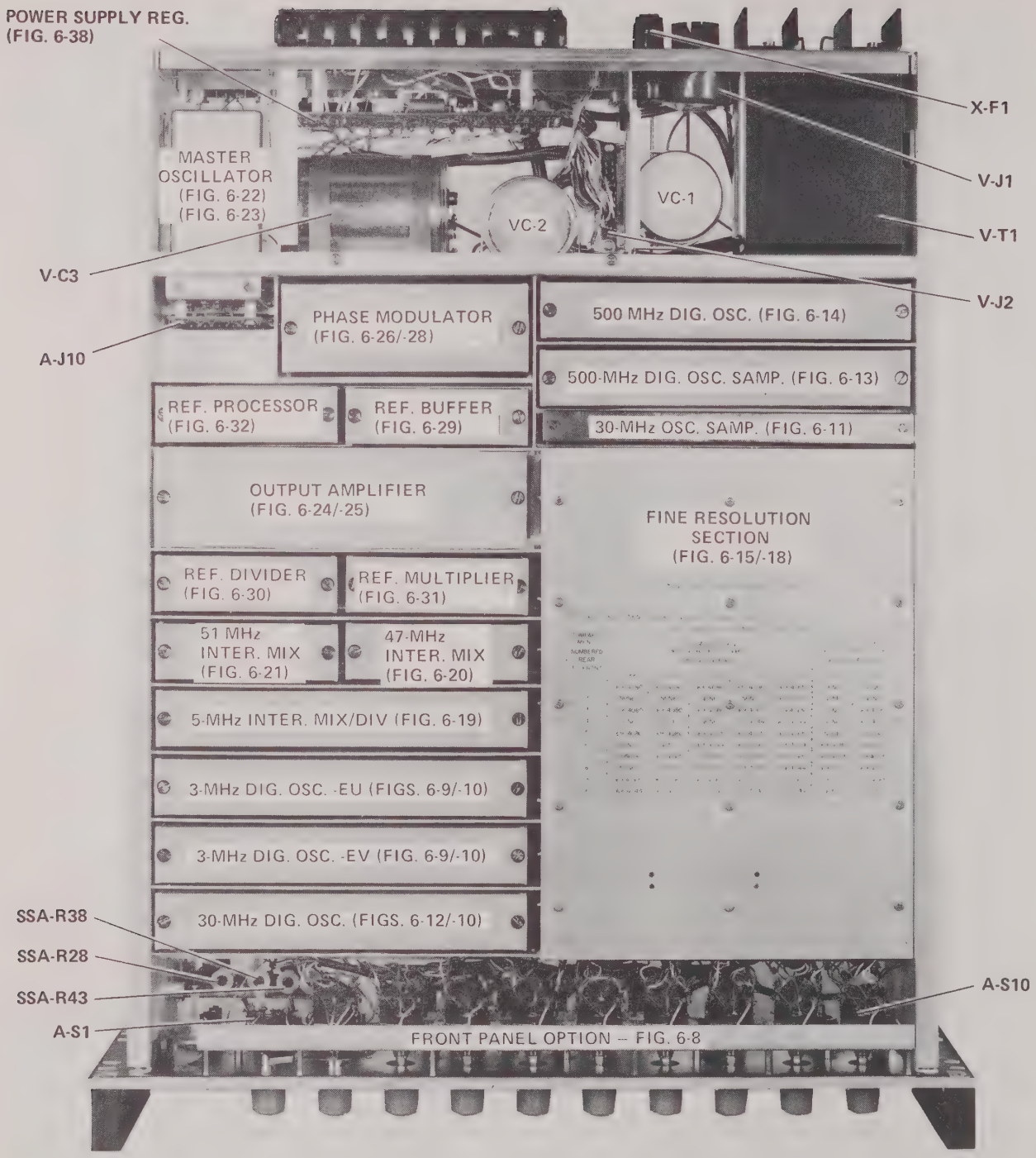


Figure 5-1. Top interior view, all options.

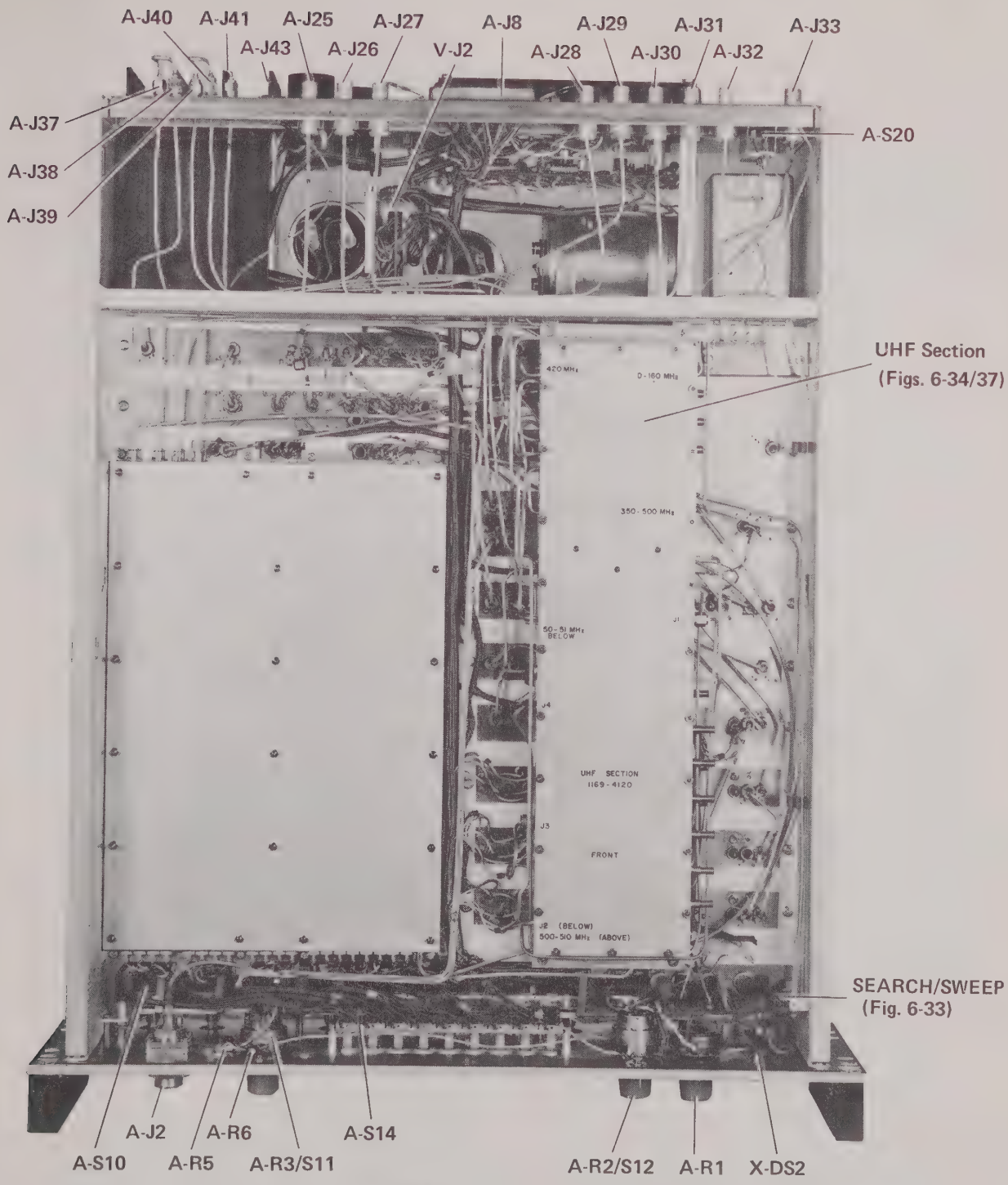


Figure 5-2. Bottom interior view.

ment, and return the defective part to the address on the tag.

5.4.2 Etched-Board Removal/Repair.

In order to isolate a circuit failure in the instrument it will usually be necessary to remove one or more etched-circuit boards to gain access to the internal signal paths. This is done by first removing an enclosure cover by alternately backing off (turning ccw) the two cover screws until the cover is free of its base. The board or boards in that enclosure can then be removed by prying gently, in the two holes at the top edge of the board, with a small screwdriver or soldering aid

Since individual boards are more easily tested and adjusted in special test fixtures at the factory, it is recommended that field repair consists of replacement of any defective board with a prealigned one. Prealigned etched-circuit boards can be obtained from the factory or, in most instances, at the nearest General Radio District Office.

5.4.3 Subassembly Removal.

Power Supply (1169-4110). To service the VA Board or power transformer, it is necessary to remove the complete power-supply assembly. Following is a procedure that can be used

a. Unplug the Power-Cable-Connector Board (A-P2) and demount rear output connector, if in place.

b. Place the instrument top-side-up.

c. Remove the screws 0.190-32 (1) and 0.138-32 (8) that hold the power transformer and rear-panel in place.

d. Remove the 0.138-32 (2) screws from the top of the capacitor assembly (near the large capacitors).

e. Carefully pull the power-supply unit straight away from the rear of the instrument.

f. Access to the VA board is obtained by removing the 4 transformer heat-sink screws from the rear and sliding the transformer shield off to the side.

Master Oscillator Unit. The master oscillator (section MO) can be removed by the following procedure:

a. Remove the 0.138-32 (2) screws from mounting bracket at the top-front of the oscillator unit.

b. Unplug the assembly by pulling upward.

c. Tip up the rear of the oscillator unit, and withdraw the unit through the opening in the partition from the top of the instrument.

Front-Panel Circuits. Better access to the circuits associated with the front-panel controls can be gained by the following procedure:

a. Remove the nuts that secure the side frames to the front panel.

b. Carefully tilt the front-panel in a direction that will allow access to the necessary component.

5.4.4 Knob and Bushing Removal.

To remove the front-panel control knobs and bushings, either to replace one that has been damaged or to replace the associated control, proceed as follows:

a. Grasp the knobs firmly with the fingers close to the panel and pull straight away from the panel.

b. Remove the handles from the front-panel by backing off the four 10/32 screws, two for each handle.

c. Remove the GR874 output connector by backing off the knurled ring and pulling the connector out of the panel from the rear.

d. Loosen the FREQUENCY SELECT locking screw and remove the slotted control.

e. Remove the ½-in. nuts (3) that hold the panel potentiometers in place. Set the frequency switches to the zero position and remove the dress panel without moving the dials.

f. Use a 3/16-in. Allen wrench to release the setscrew and pull the bushing off the shaft. The dial, marked with numerals 0 through 9 for frequency indication, is fixed to the bushing and will be removed with it.

When the front panel is removed, note that the frequency dials overlap and two different size bushings are used. Be sure to replace the dial assemblies in the same order that they were removed.

5.4.5 Knob and Bushing Installation.

To install a knob and bushing assembly proceed as follows:

a. Mount the dial and bushing assembly on the switch shaft, in proper relative position noted above, but do not tighten the setscrew.

b. Replace the dress panel and secure in place.

c. Pull the dial forward and center the zero in the dress-panel window.

d. Tighten the setscrew and check to see that the bushing does not bind when rotated.

e. Reverse steps b, c, and d of paragraph 5.4.4.

f. Place the knob on the bushing with the retention spring opposite the setscrew.

g. Push the knob in until it bottoms; pull it slightly to check that the retention spring is seated.

5.4.6 Frequency-Switch Removal.

To remove a switch assembly proceed as follows:

a. Set the switch to zero.

b. Remove the knob and loosen the bushing setscrew.

c. Unsolder the black wire connected to the frequency switch mounting bracket and any wires connected to the adjacent switches. Label the wires as they are removed so that they can be identified for reassembly.

d. Loosen the ½-in. nut that holds the switch in place.

e. Disengage the frequency select switch lug from the

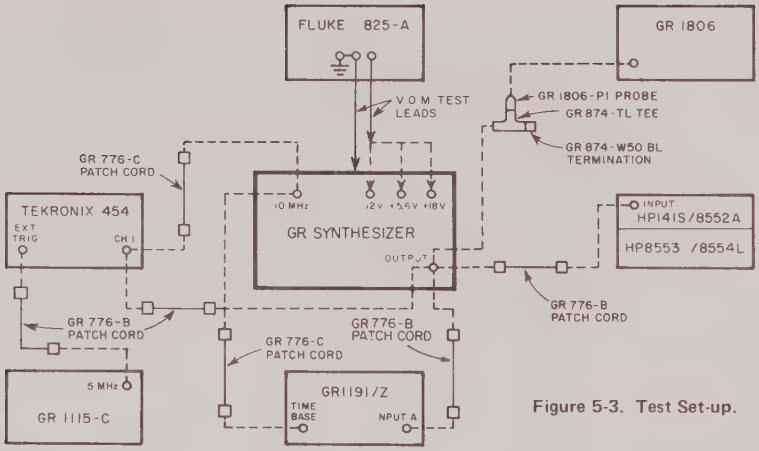


Figure 5-3. Test Set-up.

metal bar connected to the third switch wafer from the front panel.

f. Pull the switch out of the panel from the rear. If the switch is to be replaced, it is suggested that the wire connections be transferred from the original to the replacement, one at a time, to insure proper connections.

5.4.7 Frequency-Switch Installation.

To install a switch assembly proceed as follows:

a. Insert the switch, shaft-end first, through the switch-mounting bracket, ½-in. lockwasher and nut, and then through the front panel and bushing assembly.

b. Observe that the outboard end of the shaft has a flat side, (except A-S1). Set the switch to 0 by rotating the shaft so that the flat side is up. (Set A-S1 at ccw stop.) Tighten the ½-in. nut.

c. Rotate the dial assembly so that "0" is centered in the front-panel window; pull forward until the teflon washer (not visible) is bearing lightly against the inner surface of the dress panel.

d. Tighten the bushing setscrew securely to the switch shaft.

e. Replace the knob as directed in para. 5.4.5 steps d and e.

f. Solder the ground wire, and any wires removed from the original switch, to the proper terminals of the replacement switch.

5.4.8 IC Removal/Installation.

Socket Mounted. IC's that are mounted in sockets can be removed by insertion of a small-bladed screwdriver under the end of the IC and gently prying the IC up out of its socket.

When installing an IC in a socket, put all the leads from one side of the IC in the socket first and push the IC to that side until the leads on the other side line up with their socket holes. Push these leads into the socket and release the IC.

Board Mounted. An IC can be removed from an etched-circuit board with a soldering iron and a solder sucker (such as a Soldapulit*). Clean the solder from each pin on the IC and remove the IC from the board.

Insert the new IC in the holes left by the old one, and solder each pin. Be careful not to burn the etched-circuit board.

5.5 MINIMUM PERFORMANCE STANDARDS.

5.5.1 General.

Perform all checks in para. 3.4 to establish that the synthesizer meets minimum performance standards. The following additional checks may also be used. Refer to para. 5.6 if unable to obtain the performance called for in the minimum performance procedure.

5.5.2 Test Equipment.

The equipment listed in Table 5-1 is recommended for the ensuing tests. Figure 5-3 shows a test setup using this equipment.

5.5.3 Output Frequency Range.

The proper-frequency-generation check (para. 3.4.2) offers a convenient procedure to verify generation of proper frequencies. Connect equipment as shown in Figure 5-3 and make additional checks as follows:

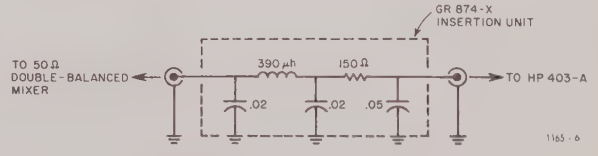


Figure 5-4. Low-pass filter (15 kHz).

a. Connect the output of the unit to the 1191/Z counter. Use the GR 776-B patch cord.

b. Connect the counter rear-panel TIME BASE connector to the synthesizer rear-panel 10 MHz OUT connector.

*Registered trademark of Edsyn, Inc., 15954 Arminta St., Van Nuys, California, 91406.

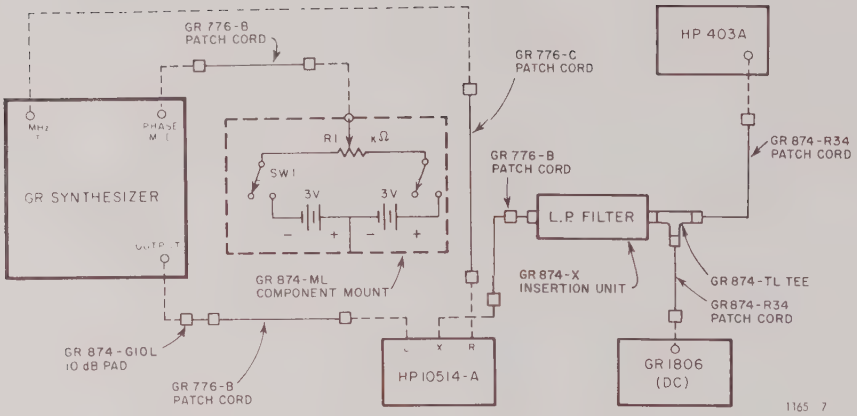


Figure 5-5. Phase- and amplitude-noise modulation measurement setup.

This locks the counter time base to the master oscillator. Use the GR 776-C patch cord.

c. Set the X10-kHz dial to "1" and the other dials to "0".

d. Set the counter to measure frequency with a 1 sec counting time. The counter should indicate 10 kHz ±1 count.

NOTE

Minimum frequency available at the OUTPUT is 400 kHz.

e. Advance the X 1 Hz dial through each step from "0" to "9". Notice that the counter indication increases by 1 count with each step.

f. Repeat the observations at step-digit settings for the X10 Hz, X100 Hz, X1 kHz, X100 kHz, X1 MHz, and X10 MHz dials and observe the counter indication. To check the 0.1 Hz steps use a 10 sec counting time.

The above checks serve the primary function of assuring that the signal paths from the digit oscillators to the output section are functioning properly, over the entire frequency range. (In Remote Only option instruments, frequency programming by external means must be used for these checks).

5.5.4 Output Amplitude.

The amplitude variations, from the lowest indication to the highest, must be less than 0.6 dB from 2.0 MHz to 160 MHz (2 dB from 400 kHz to 2 MHz).

Use the following procedure to check the output amplitude response:

a. Set the synthesizer output frequency to 10 MHz.

b. Connect the 1806-P1 Probe and the GR874-W50BL 50 Ω termination to the 1806-P1 Tee.

c. Connect the GR 1806-P1 Tee and 1806-P1 probe to the OUTPUT connector of the synthesizer.

d. Adjust the synthesizer OUTPUT LEVEL control (or external level program voltage) for an indication of 2.24 V on the 1806 Voltmeter.

e. Vary the synthesizer output frequency from 2 MHz to 160 MHz and note that the response, as indicated by the 1806 Voltmeter, varies no more than ±3%.

f. Vary the synthesizer output frequency from 400 kHz to 2 MHz and again note that the response varies no more than −6% and +18%.

5.5.5 Spurious Frequency Outputs.

Connect a spectrum analyzer to the OUTPUT connector of the synthesizer.

a. Set the synthesizer dials to the desired frequency and adjust the OUTPUT level control for maximum output.

b. Check the analyzer for nonharmonic and harmonic spurious signals. Harmonic (at maximum output with 50 Ω load): 0.4 to 160 MHz < 27 dB. Discrete nonharmonic: 0.4 to 160 MHz < 80 dB.

5.5.6 Phase and Amplitude Noise Modulation.

Phase-noise modulation is not critically dependent on the output frequency. It can be measured by using the rear-panel 10 MHz OUT signal to check the synthesized output at 10 MHz. Figure 5-5 shows the recommended setup for measuring both phase and amplitude noise modulation of the synthesizer OUTPUT. The HP 10514-A Double-Balanced Mixer output must be fed through a 15-kHz low-pass filter (Figure 5-4) to comply with specifications. The shielded ±3-V battery and potentiometer, feeding the rear-panel PHASE MOD input, permits relative phase adjustment of the output and reference sources. The noise meter must have sufficient sensitivity to measure at least 65 dB down from the calibrate level, which is approximately 250 mV in the setup shown.

For minimum effects from stray capacitance and magnetic fields, the filter circuit and the battery-potentiometer circuit (shown in Figure 5-5) should be mounted in shielded enclosures. The GR 874-X Insertion Unit (P/N 0874-9990) is recommended as a convenient mounting device for the former and the GR 874-ML Component Mount (P/N 0874-9663) is suitable for the latter. Mount the 1-kΩ

potentiometer (R1) inside the component mount so that the adjustment screw aligns with one of the holes in the mount cover. The J.F.D. Adjustment Tool number 5284, is a convenient tool for adjusting R1.

Make the connections as shown in Figure 5-5. To calibrate the phase- and amplitude-noise modulation measuring system, set the frequency dials to read 10,001,000 Hz† and adjust the OUTPUT level control to produce a convenient reference indication on the noise meter, such as −10 dB.

To measure the phase-noise modulation follow this procedure:

a. Set the frequency dials to 10,000,000 Hz.

b. Set SW1 (Figure 5-5) to the closed position.

NOTE

Set SW1 to the off position when not in use.

c. Adjust R1 (Figure 5-5) for 0-V dc out of the mixer.

d. Increase the noise-meter sensitivity until an indication of phase-noise modulation is obtained. It should be at least −63 dB.

To measure the Amplitude-Noise Modulation follow this procedure:

a. Perform the calibration procedure above.

b. Set the frequency dials to 10,000,000 Hz.

c. Set SW1 (Figure 5-5) to the closed position.

d. Adjust the battery potentiometer for maximum dc out of the mixer.

e. Remove the 1806 – this eliminates possible effects on the amplitude-noise modulation measurement.

f. Observe the amplitude-noise modulation on the noise meter to be at least −75 dB.

5.6 TROUBLE ANALYSIS.

5.6.1 General.

Sectional construction of the unit simplifies trouble analysis and repair. Most circuits are divided, both functionally and physically, among up to 27 plug-in etched-circuit boards; 13 of them plug into single-board shielded enclosures; 4 of them plug into double-board shielded enclosures, which are internally divided into 2 compartments, and up to 10 of them plug into the fine resolution section. Each enclosure cover is forced on or off with 2 captive screws, providing easy access to the etched boards. Trouble analysis to the etched board level only is recommended.

Detailed block diagrams (Figures 6-5, 6-6 and 6-7) provide nominal power-supply voltages, signal frequencies and signal levels. This information should be used in conjunction with the schematic diagrams as an aid for locating a malfunction.

The 50-Ω load termination, specified for many of the signal levels, is not mandatory for general signal tracing with a high-impedance probe. However, a 50-Ω load must be provided where specified for final testing or calibration.

Performance of the tests described in para. 5.5 will in many cases suggest to a user, thoroughly familiar with synthesizer operation, where a malfunction is originating. If no output signal is present, it is necessary to perform other tests to locate the problem. A logical starting point is the power supply.

5.6.2 Trouble-Analysis Procedures.

If the synthesizer output is abnormal or if no output is present, use the following procedures (in the order presented) to isolate the problem

Power Supply. Three rear-panel pin jacks provide a means of checking power-supply voltages. If any of them are absent, first check the wiring between the rear-panel socket and the power supply. Once a malfunction is isolated to the power supply, systematically check the voltages shown on Figure 6-38.

A component replacement, in most cases, will not require readjustment of the supplies. However, an adjustment procedure is included for use where necessary.

Use the following procedure to check or adjust the power-supply voltages:

NOTE

Do not adjust these voltages unless absolutely necessary.

a. Use the John Fluke Differential DC Voltmeter Model 825A or equivalent. Set the controls as follows:

RANGE control	– – – 50
Null control	– – – 0.1
Input control	– – – (–)
A-E controls	– – – 12.000

b. Connect the −12 V pin jack to the differential dc voltmeter input. Use a multimeter test lead and insert the probe into the pin jack.

c. Connect the synthesizer chassis to the differential voltmeter ground terminal. The ground terminal shorting bar should be connected to the low input terminal.

d. Check or adjust the −12 V supply to be within 0.02 V as indicated by the Fluke 825-A. Coarse and fine controls are provided for ease of setting.

NOTE

Step d must be executed before step e.

e. Repeat step d for the +18 ±.02 V and +5.6 ±.02 V supplies.

Master Oscillator. Connect the 454 scope to the rear-panel 10-MHz jack. This signal comes from the master oscillator unit via sections RP and RB. If no signal is present at the rear-panel jack, remove the RBA board and check for a signal at terminal 5. If no signal there, remove

†10,010 kHz may be used on minimum-resolution option instruments.

the RPA board and check for a signal at terminal 18. Frequency accuracy is not important at this point. Look for the absence (or presence) of the signal, or for a frequency that is significantly different from 10 MHz.

With external drive, check the output signal of the drive source.

Other Modules. With no clue to the problem at this juncture, an assumption can be made that the malfunction is in one of the other modules. A recommended procedure is to check the outputs and inputs of each module starting with section OA and working back toward the digit oscillators. Use the 1806 electronic voltmeter, with an ac probe and a short ground lead, to measure the levels; use the 454 scope with the P6047 probe to measure frequency up to 150 MHz. Above this frequency use the 1191/Z or a scope with a higher frequency limit.

Figures 6-5, 6-6 and 6-7 list the levels as dBm into a 50-Ω load; however, for convenience the termination can be eliminated when troubleshooting. This will allow the measurements to vary as much as 3 to 1, but the detection of the presence or absence of a level is all that is necessary to isolate the problem to a particular board.

NOTE

Matched boards are used in sections EW/EX, OA, and GX/GY. If a board from any of these sections has to be returned for repair, return both boards for the particular section involved. Refer to para. 5.4.1 and/or the parts list for part numbers.

5.7 OUTPUT ADJUSTMENTS.

5.7.1 General.

The trouble-analysis procedure could result in the replacement of one or more etched-circuit boards. If that is the case, the adjustment procedures presented in this para. should be checked to insure proper operation.

5.7.2 Master Oscillator Frequency.

The master oscillator must be adjusted periodically, to correct for normal crystal aging. A rear-panel screwdriver adjustment is provided for that purpose on the high stability oscillator.

NOTE

Before attempting to make this adjustment, allow the master oscillator to operate for a minimum of 2 hours.

Use the following procedure to adjust the master-oscillator frequency:

a. Connect the 1115-C 5-MHz output to the Tektronix Model 454 oscilloscope EXT TRIG. Use the GR 776-B patch cord.

b. Set the scope controls as follows:

"A" TRIGGER (source) – – – – EXT
TIME/DIV – – – – – – – – – – 0.05 μs
MODE TRIGGER – – – – – – – CH1
HORIZ DISPLAY (mag) – – – – X10
"A" SWEEP LENGTH – – – – – FULL
VOLTS/DIV (CH1) – – – – – – 1 V

c. Set the frequency dials to 100,000,000 Hz.

d. Set the OUTPUT control to 1 V.

e. Connect the OUTPUT to the scope CH1 INPUT.

f. A 100-MHz sinewave pattern will appear on the CRT and two divisions of the graticule will represent one complete cycle. Using an insulated screwdriver (such as the GC 8290)* adjust the master-oscillator frequency control until the sinewave pattern stops moving or slows to a rate of less than 2 div/sec. The master oscillator frequency is now set to an accuracy $\geq 1 \times 10^{-8}$.

The moderate stability master oscillator is adjusted from the top of the instrument so it must be removed from the cabinet for this adjustment. The oscillator can be adjusted in a manner similar to that for the high stability oscillator except setting to within 1×10^{-7} is adequate and this can be done by observing a 10 MHz output on a .05 μs/division display and adjusting for less than 2 div/sec drift.

5.7.3 Output Level Control. (Figure 5-2)

Use the following procedure to calibrate the OUTPUT level control:

a. Adjust A-R5 for 2.24-V r-f output with control set to +20 dBm. Adjust A-R6 for 0.224 V with control set to 0 dBm. These controls are accessible from the bottom of instrument.

b. Check the 13 dBm position at 1.0 V output to be within ±1 dB. If any of these output control settings exceed specifications, remove the control knob and slip the bushing to compensate for the discrepancy. Replace the knob and recheck the same positions.

c. Set the output control to the +20-dBm position. Vary the synthesizer output frequency from 400 kHz to 160 MHz and observe the response as indicated by the voltmeter. Variations from the lowest indication to the highest must be less than 2 dB.

5.8 AUXILIARY OUTPUTS.

Two auxiliary fixed-frequency outputs are available from separate rear-panel BNC jacks. One is a 1-MHz square-wave signal of 2-V pk-pk, into 10-kΩ; the other is a 10-MHz sinusoid signal of 0.5 ±0.05 V rms, into 50 Ω. Also available are outputs of 500 to 510 MHz and 500 to 350 MHz. They must be looped back to corresponding inputs for normal instrument operation.

The rear-panel power supply test points can also be used as auxiliary voltage outputs; do not exceed 50 mA loads.

*General Cement or equivalent.

5.9 PREVENTIVE MAINTENANCE

5.9.1 Cleaning the Exterior.

Loose dust accumulating on the outside of the instrument can be removed with a lint-free cloth or a small paint brush. A paint brush is particularly useful for dislodging dust on and around the front-panel controls. A soft cloth, dampened with water and a small amount of keolite, can be used to remove a harder coating of dirt. Abrasive cleansers should not be used.

5.9.2 Cleaning the Interior.

Dust that penetrates the interior of the instrument should be removed at regular maintenance periods, since a heavy accumulation of dust can cause the instrument to overheat. Since some internal adjustments might be disturbed, it is suggested that the instrument interior be cleaned before recalibration.

Perhaps the best way to clean the interior of the instrument is to blow off dust using low-velocity compressed air. To prevent damage to components, avoid a high-velocity air stream. Persistent dirt can be removed using a damp cloth or a small paint brush. A cotton-tipped applicator, dampened with alcohol, can be used for cleaning in narrow spaces.

5.9.3 Visual Inspection.

Many potential and existent troubles can be detected by a visual inspection of the instrument. For this reason, you should perform a complete visual check every time the instrument is calibrated or repaired and during other routine maintenance work.

Defects that may be detected visually include such things as loose or broken connections, loose set screws in knobs, loose or damaged connectors, improperly seated devices, and scorched or burned parts. The remedy for most of these troubles is apparent. However, particular care must be taken when heat-damaged components are detected. Overheating of parts is often the result of other, less apparent, defects in the circuit. It is essential that you determine the cause of overheating before replacing heat-damaged parts, in order to prevent further damage.

5.10 LUBRICATION

The only parts on the instrument requiring lubrication are the digit-selector switches, found only on instruments with the front-panel control option, OP1. These switches are lubricated at the factory and should require no further lubrication.

The only assemblies requiring mechanical alignment are the dials related to the above-mentioned switches, and the alignment details are given in para. 5.4.7.

Table 5-1
TEST EQUIPMENT

Function	Recommended Type or Model*	Performance Characteristics
Frequency programming switch	Type 378 DIGISWITCH, ♦ 10 station	BCD contact closures to ground to exercise decade steps via A-J 8.
Electronic Voltmeter (VTVM)	GR 1806 (with 1806-P1)	1.5 – 1500 V full scale, ±2% accuracy
Power Meter	HP 431 (with 428 A)	–20 to +10 dBm full scale, ±1% accuracy
AC Voltmeter	HP 403-A	100 μV - 300 V, dB range - 60 to 50 dB
Dc Differential Voltmeter	John Fluke 825-A	0-500 V accuracy ±0.02% +25 μV below 0.1 V
VOM	Triplet 630 NA	Dc accuracy ±2%
Metered Variac®	GRW5MT3W	300 W/150 V, full scale, meters
Oscilloscope	Tektronix† 454	Dc to 150 MHz (with P6047 probe).
Counter with Scaler	GR 1191/Z	Dc to 500 MHz
Spectrum Analyzer	HP 141S/8552A 8553 /8554L	1 kHz - 1.2 GHz
Double Balanced Mixer	HP 10514-A	"L" and "R" ports: 200 kHz to 500 MHz "X" port: dc to 500 MHz
Frequency Standard	GR 1115-C	Output Frequencies: 5 MHz, 1 MHz, and 100 kHz
Coaxial Adaptor	GR 874-QTNP	For 1062-9000 only required at OUTPUT.
Patch cord	GR 766-C (2)	BNC plug to BNC, 3 ft.
Patch cord	GR 776-B (2)	GR 874 to BNC, 3 ft.
Patch cord	GR 874-R34	GR874 connector , 3 ft.
Coaxial Tee	GR 874-TL	Locking version
Coaxial Load	GR W50BL	50 Ω ±0.5%
Coaxial Pad	GR 874-G10L	50 Ω 10 ±0.15 dB
Insertion Unit	GR 874-X	2 in. long, 9/16-in. dia.
Component Mount	GR 874-ML	2 5/8-in. long, 3-in. dia.
Coaxial Adaptor	GR 874-QNJ	GR874 to type-N plug

*Or equivalent

♦Digitran Co., 855 S. Arroyo Pkwy., Pasadena, CA.

†Reg. trademark, Tektronix Inc., Beaverton, Ore.

Parts Lists and Diagrams – Section 6

Item	Page
Mechanical parts	6-2
Functional Diagrams	6-4
Block diagrams	6-7
Federal Manufacturer's Code	6-8
Schematic diagram — panel circuit	6-9
3-MHz digit oscillator	.6-11
Sweep-enable circuit	.6-13
30-MHz digit oscillator sampler	.6-15
30-MHz digit oscillator	.6-17
500-MHz digit oscillator sampler	.6-19
500-MHz digit oscillator	.6-21
Motherboard (fine resolution-standard)	.6-23
Motherboard (fine resolution-economy)	.6-25
5.01 MHz mixer divider	.6-27
2 decade digit oscillator programmer	.6-29
2 decade digit oscillator	.6-31
5.1 MHz mixer divider	.6-33
Inter. mixer (47 MHz)	.6-35
Inter. mixer (51 MHz)	.6-37
Master oscillator — mod. stability	.6-39
Master oscillator — high stability	.6-39
Output amplifiers	6-41/-43
Phase modulator input amplifier	.6-45
Phase modulator	.6-47
Phase modulator multiplier	.6-49
Reference buffer	.6-51
Reference divider	.6-53
Reference multiplier	.6-55
Reference processor	.6-57
Search/Sweep driver	.6-59
UHF Section	.6-60
UHF Mixers and Filter	.6-61
UHF Amplifiers	.6-63
Power Supply	.6-65

NOTE

Electrical parts information in this section is presented in such a way that all the data for a part-numbered subassembly is visible in a single opening of the manual. Thus, the parts list appears on left-hand pages, while the part-location diagram (on the apron) and the schematic diagram (tip out) are on right-hand pages. Most of the subassemblies are plug-in boards, to permit rapid replacement should failure occur.

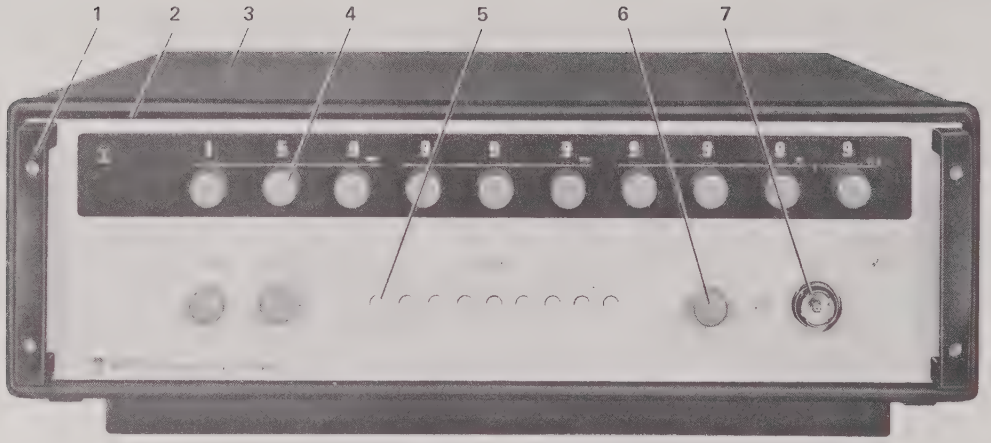


Figure 6-1. Mechanical parts, front panel, Option 1 versions only.

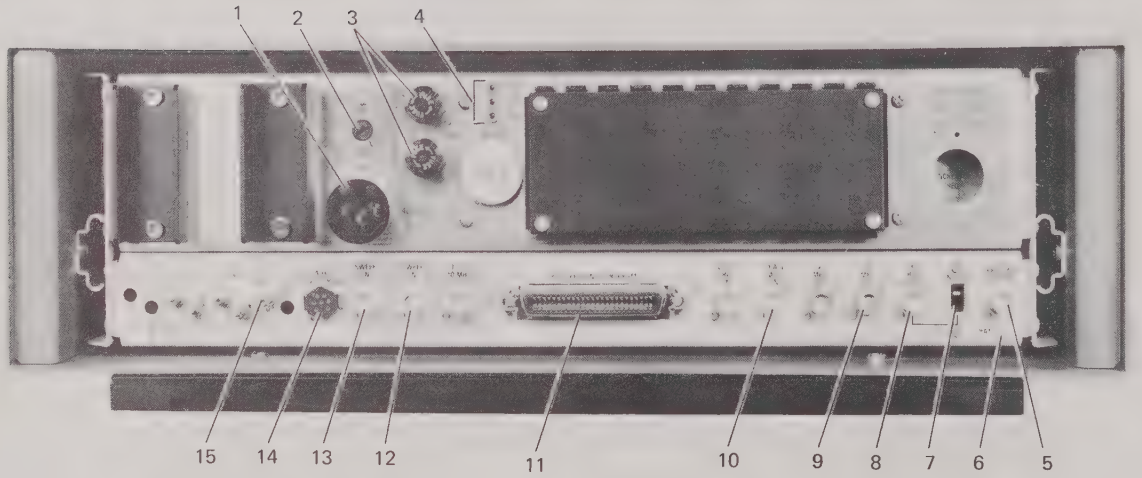


Figure 6-2. Mechanical parts, rear panel.

MECHANICAL PARTS LIST

Fig Ref	Qnt	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
FRONT PANEL					
1	2	Handle	5360-2012	24655	5360-2012
2	1	Cabinet gasket	5331-2168	24655	5331-2168
3	1	Bench cabinet asm. includes:			
	1	bench cabinet	4173-3843	24655	4173-3843
	1	base	4171-1077	24655	4171-1077
	2	foot	4171-7022	24655	4171-7022
4	10	Knob asm., grey includes:			
		retainer	5220-5402	24655	5220-5402
5	1	Knob, pushbutton, multiple 9, A-S14 DIGIT REPLACED	5511-0402	24655	5511-0402
6	3	Knob asm, grey REMOTE 0,4,7,10,13,15,17,20 MULTIPLIER -1,0,1,2,3,4,5,6,7,8,9,10,0 REMOTE ONLY	5520-5221	24655	5520-5221
7	1	Connector, bulkhead,	4260-1190	08168	2004-7985

MECHANICAL PARTS LIST

Fig Ref	Qnt	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
REAR PANEL						
1	1	Receptacle, Power, C.E.E., Std., J-1 OFF/48-66 Hz	4240-0210	24655	4240-0210	
2	1	Switch, Line Voltage, S-1 LINE VOLTAGE/OFF 90/110, 104/127, 180/220, 194/236, 207/253	7890-1382	24655	7890-1382	
3	2	Fuse Extractor Post XF-1,2 1A/1/2 A	5650-0100	71400	HKP-H	5920-284-7144
4	3	Connector, Jack J-3,4,5 +18 V, -12 V, +5.6 V	4260-1010	91916	SKT-8	
5	1	Cable Asm., BNC A-J33 DC FREQUENCY CONTROL	1169-2200	24655	1169-2200	
6	1	Connector, jack A-J34 BAT	4270-0975	07264	#FT-M-8	
7	1	Switch, Slide, DPDT A-S20 INT OFF	7910-0832	82389	11A-1118	
8	1	Cable Asm., BNC A-J32 EXT REF INPUT	1169-2204	24655	1169-2204	
9	1	Cable Asm. A-J31	1169-2850	24655	1169-2850	
10	1	Connector, BNC A-J29 PHASE MOD IN	1169-2854	24655	1169-2854	
11	1	Connector A-J8 BCD FREQUENCY PROGRAM	4230-4049	93916	57-40500	5935-062-1776
12	1	Cable Asm. A-J26 SWEEP IN 2	1169-2858	24655	1169-2858	
13	1	Cable Asm. A-J25 SWEEP IN 1	1169-2852	24655	1169-2852	
14	1	Connector, Mult., Socket, 7 cont. A-J43 AUX LEVEL PROG	4230-5406	02660	126-198	
15	1	Cable Asm. A-J41 42 MHZ/TERM IN 50 Ω	1169-2550	24655	1169-2550	

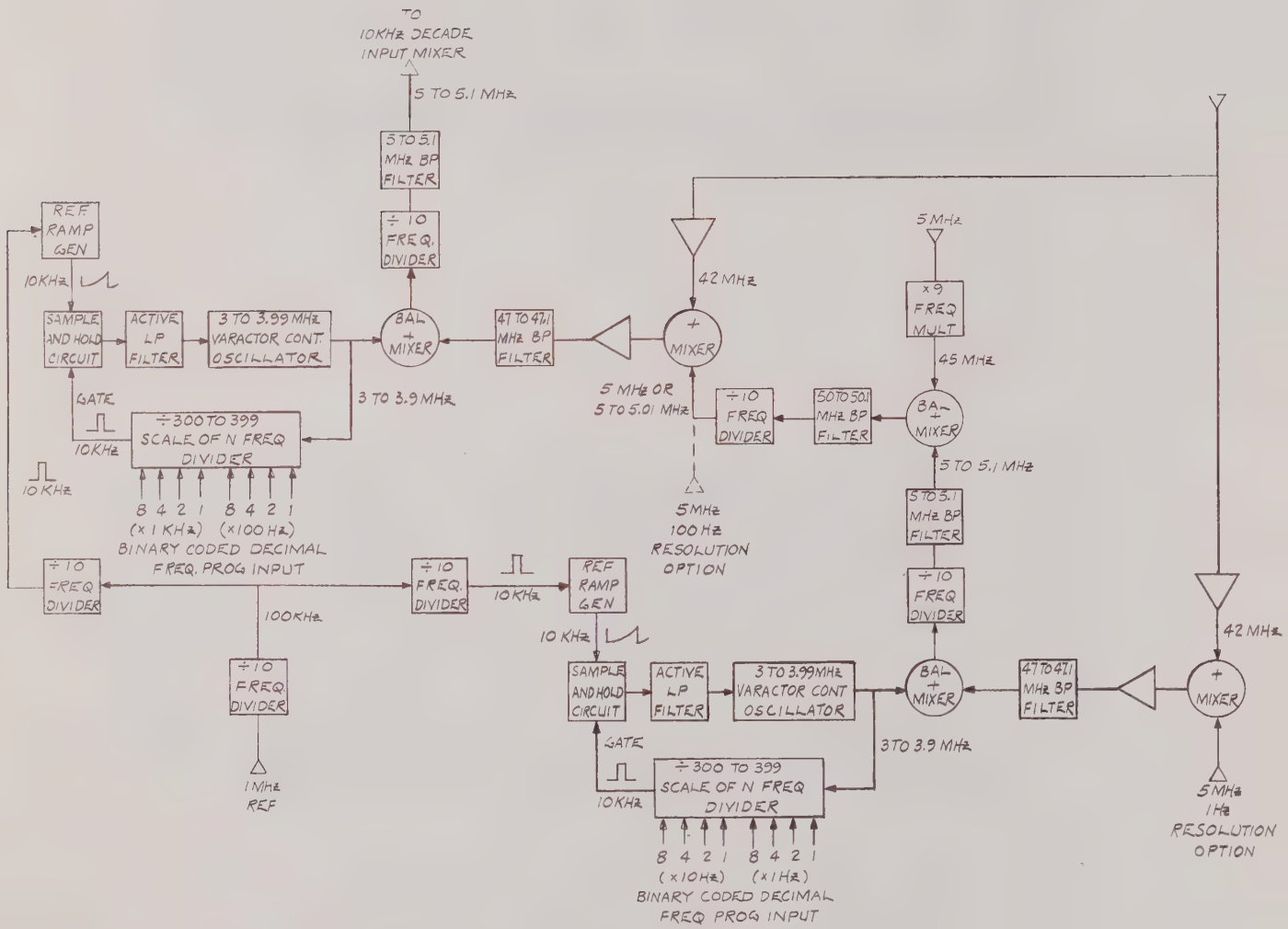


Figure 6-3. Functional diagram — economy resolution only.

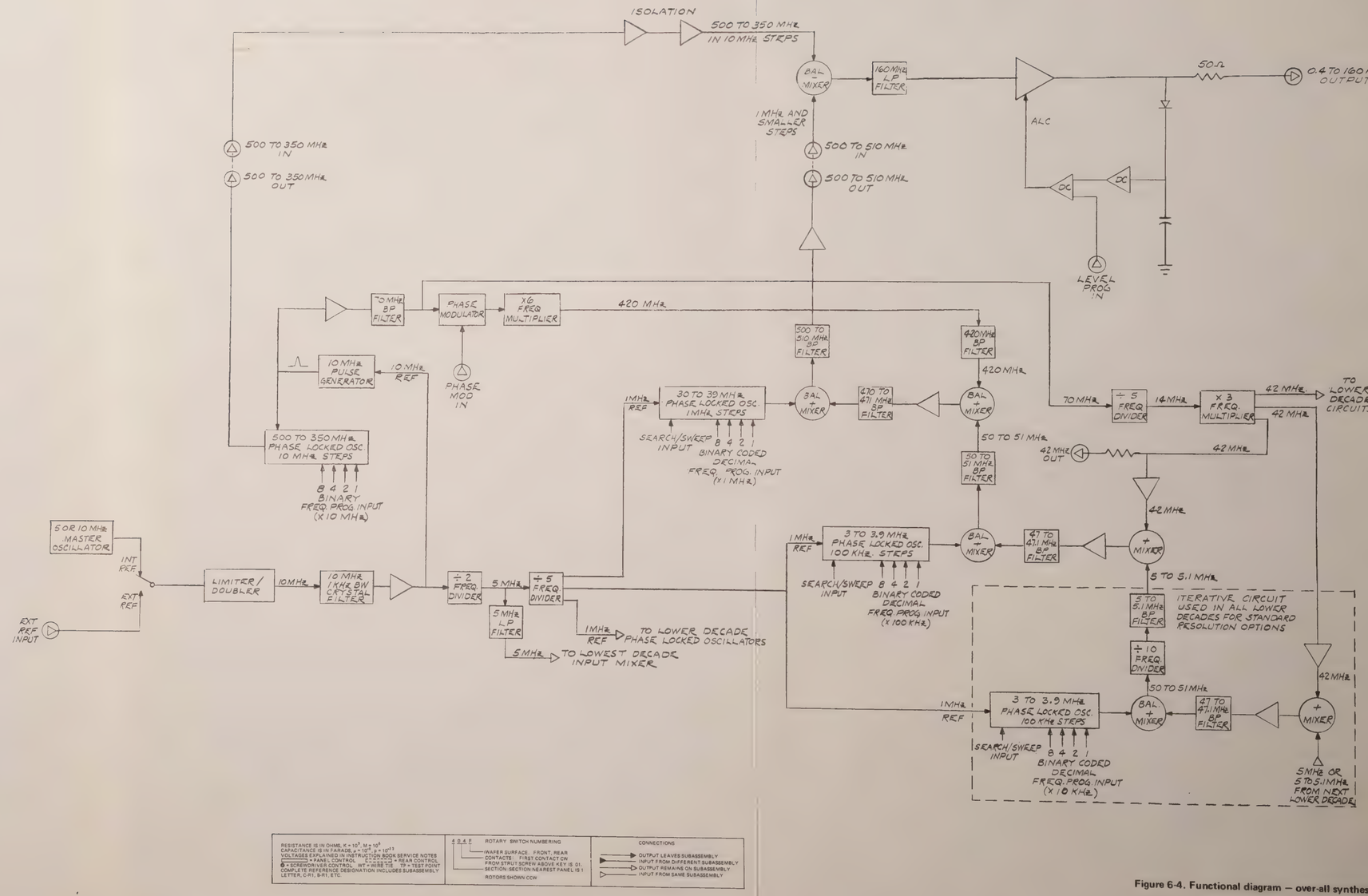
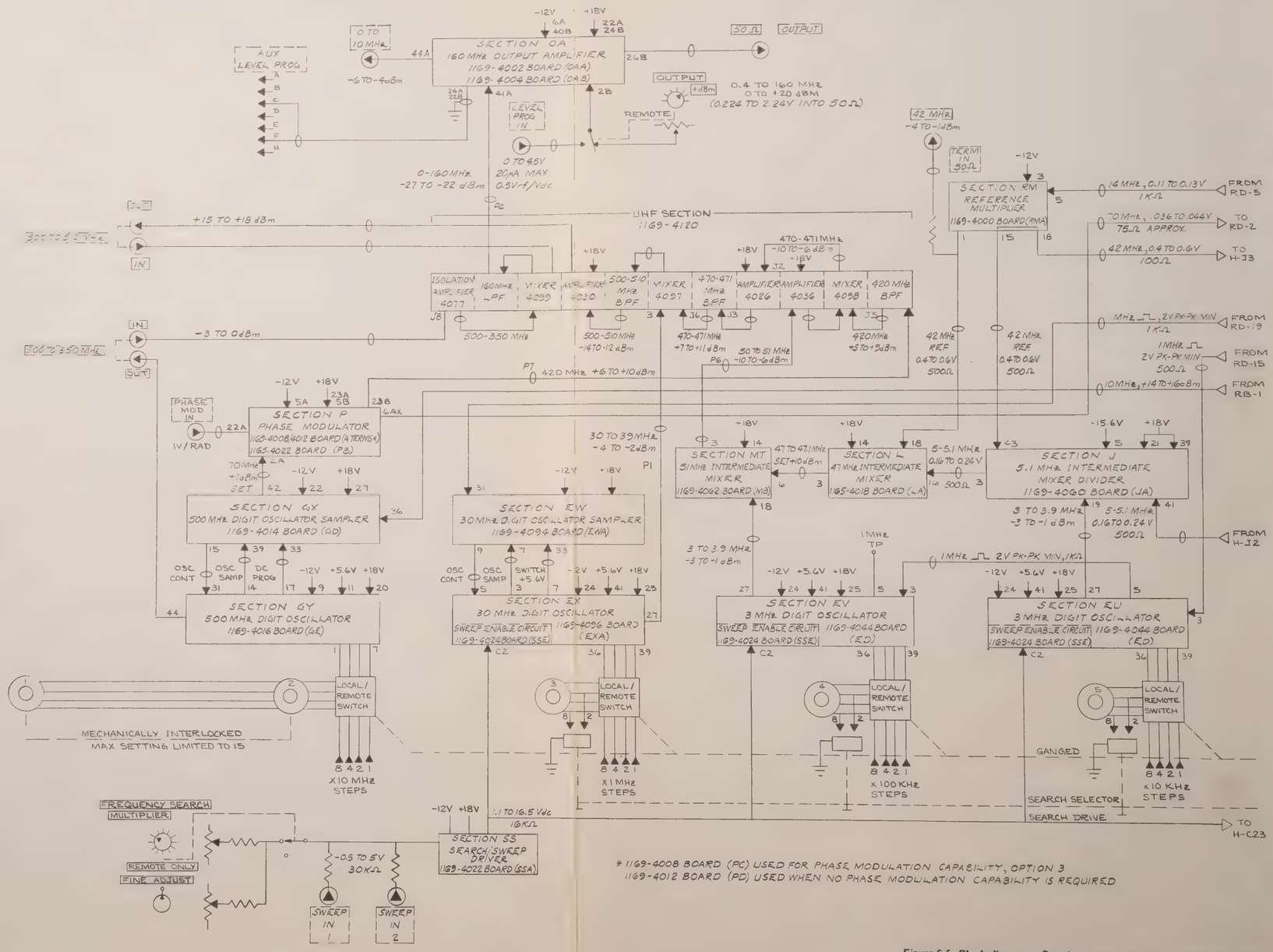

ISOLATION
500 TO 350 MHz IN 10 MHz STEPS
BAL MIXER
160 MHz LP FILTER
50 Ω
0.4 TO 160 MHz OUTPUT
1 MHz AND SMALLER STEPS
500 TO 510 MHz IN
500 TO 510 MHz OUT
ALC
DC
DC
LEVEL PROG IN
500 TO 350 MHz IN
500 TO 350 MHz OUT
70 MHz BP FILTER
PHASE MODULATOR
X6 FREQ MULTIPLIER
420 MHz
500 TO 510 MHz BP FILTER
420 MHz BP FILTER
10 MHz PULSE GENERATOR
10 MHz REF
PHASE MOD IN
1 MHz REF
30 TO 39 MHz PHASE LOCKED OSC. 1 MHz STEPS
BAL MIXER
470 TO 471 MHz BP FILTER
BAL MIXER
70 MHz
÷ 5 FREQ. DIVIDER
14 MHz
X 3 FREQ. MULTIPLIER
42 MHz
TO LOWER DECADE CIRCUITS
42 MHz
SEARCH/SWEEP INPUT
B 4 2 1 BINARY CODED DECIMAL FREQ. PROG. INPUT (X 1 MHz)
50 TO 51 MHz
42 MHz OUT
42 MHz
50 TO 51 MHz BP FILTER
42 MHz
500 TO 350 MHz PHASE LOCKED OSC. 10 MHz STEPS
B 4 2 1 BINARY FREQ. PROG. INPUT (X 10 MHz)
1 MHz REF
3 TO 3.9 MHz PHASE LOCKED OSC. 100 KHz STEPS
BAL MIXER
47 TO 47.1 MHz BP FILTER
MIXER
5 TO 5.1 MHz
SEARCH/SWEEP INPUT
B 4 2 1 BINARY CODED DECIMAL FREQ. PROG. INPUT (X 100 KHz)
ITERATIVE CIRCUIT USED IN ALL LOWER DECADES FOR STANDARD RESOLUTION OPTIONS
5 OR 10 MHz MASTER OSCILLATOR
INT REF
EXT REF
EXT REF INPUT
LIMITER / DOUBLER
10 MHz
10 MHz 1 KHz BW CRYSTAL FILTER
÷ 2 FREQ. DIVIDER
5 MHz
÷ 5 FREQ. DIVIDER
5 MHz LP FILTER
1 MHz REF
TO LOWER DECADE PHASE LOCKED OSCILLATORS
5 MHz
TO LOWEST DECADE INPUT MIXER
5 TO 5.1 MHz BP FILTER
÷ 10 FREQ. DIVIDER
50 TO 51 MHz
1 MHz REF
3 TO 3.9 MHz PHASE LOCKED OSC. 100 KHz STEPS
BAL MIXER
47 TO 47.1 MHz BP FILTER
MIXER
SEARCH/SWEEP INPUT
B 4 2 1 BINARY CODED DECIMAL FREQ. PROG. INPUT (X 10 KHz)
5 MHz OR 5 TO 5.1 MHz FROM NEXT LOWER DECADE
RESISTANCE IS IN OHMS, K = 10³, M = 10⁶
CAPACITANCE IS IN FARADS, μ = 10⁻⁶, p = 10⁻¹²
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
R = FRONT PANEL CONTROL R = REAR CONTROL
S = SCREWDRIVER CONTROL WT = WIRE TIE TP = TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-R1, B-R1, ETC.
4 0 4 F
WAFER SURFACE FRONT REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION SECTION NEAREST PANEL IS 1
ROTORS SHOWN CCW
ROTARY SWITCH NUMBERING
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

Figure 6-4. Functional diagram — over-all synthesizer.



* 1169-4008 BOARD (PC) USED FOR PHASE MODULATION CAPABILITY, OPTION 3
1169-4012 BOARD (PD) USED WHEN NO PHASE MODULATION CAPABILITY IS REQUIRED

Figure 6-5. Block diagram — Part 1 — coarse resolution and output sections (1 of 2).

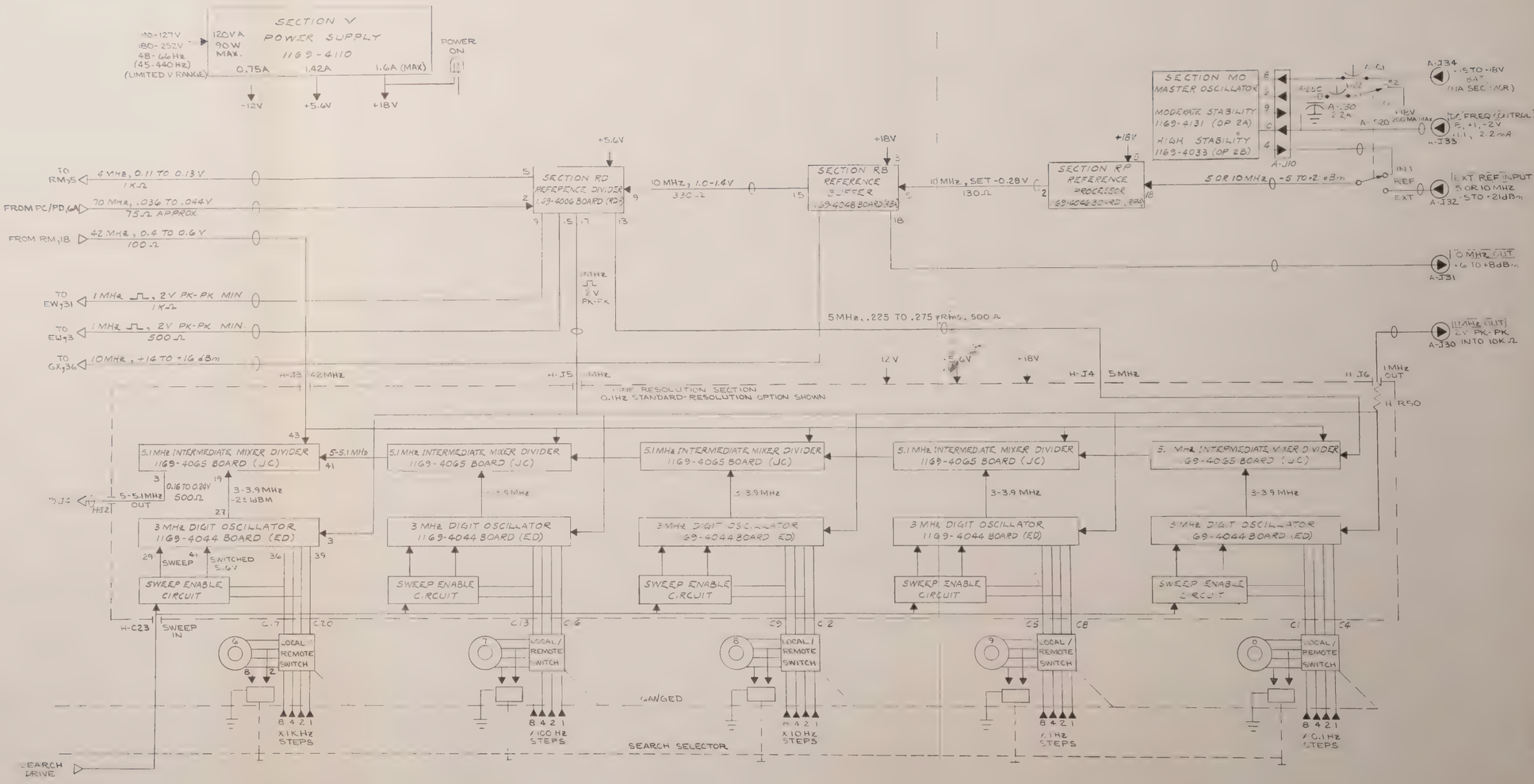


Figure 6-6. Block diagram — Part 2 — fine-resolution, frequency-reference, and power-supply sections (2 of 2).

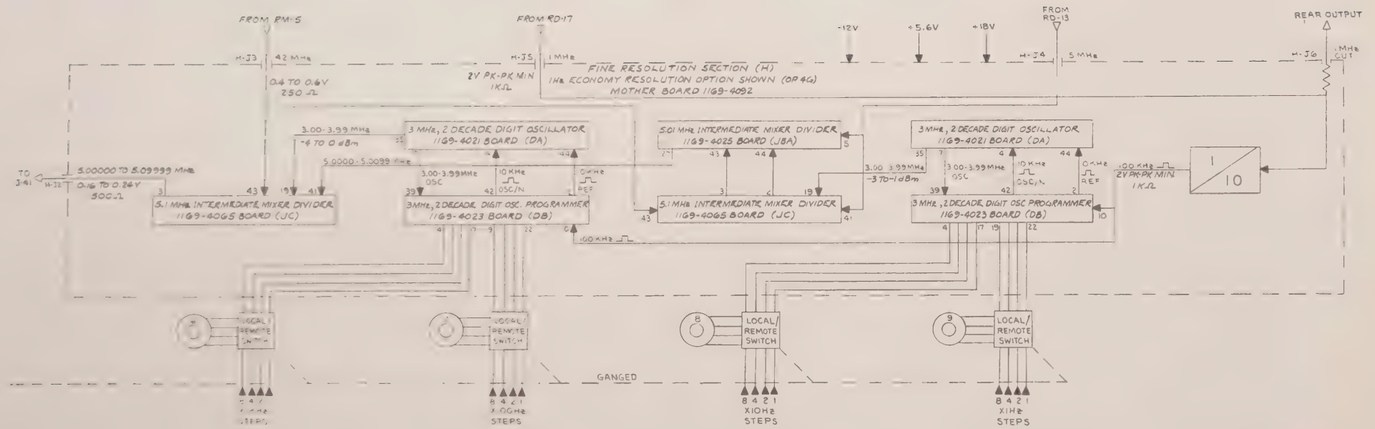


Figure 6-7. Block diagram — economy resolution section.

FEDERAL MANUFACTURER'S CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) as supplemented through August, 1968.

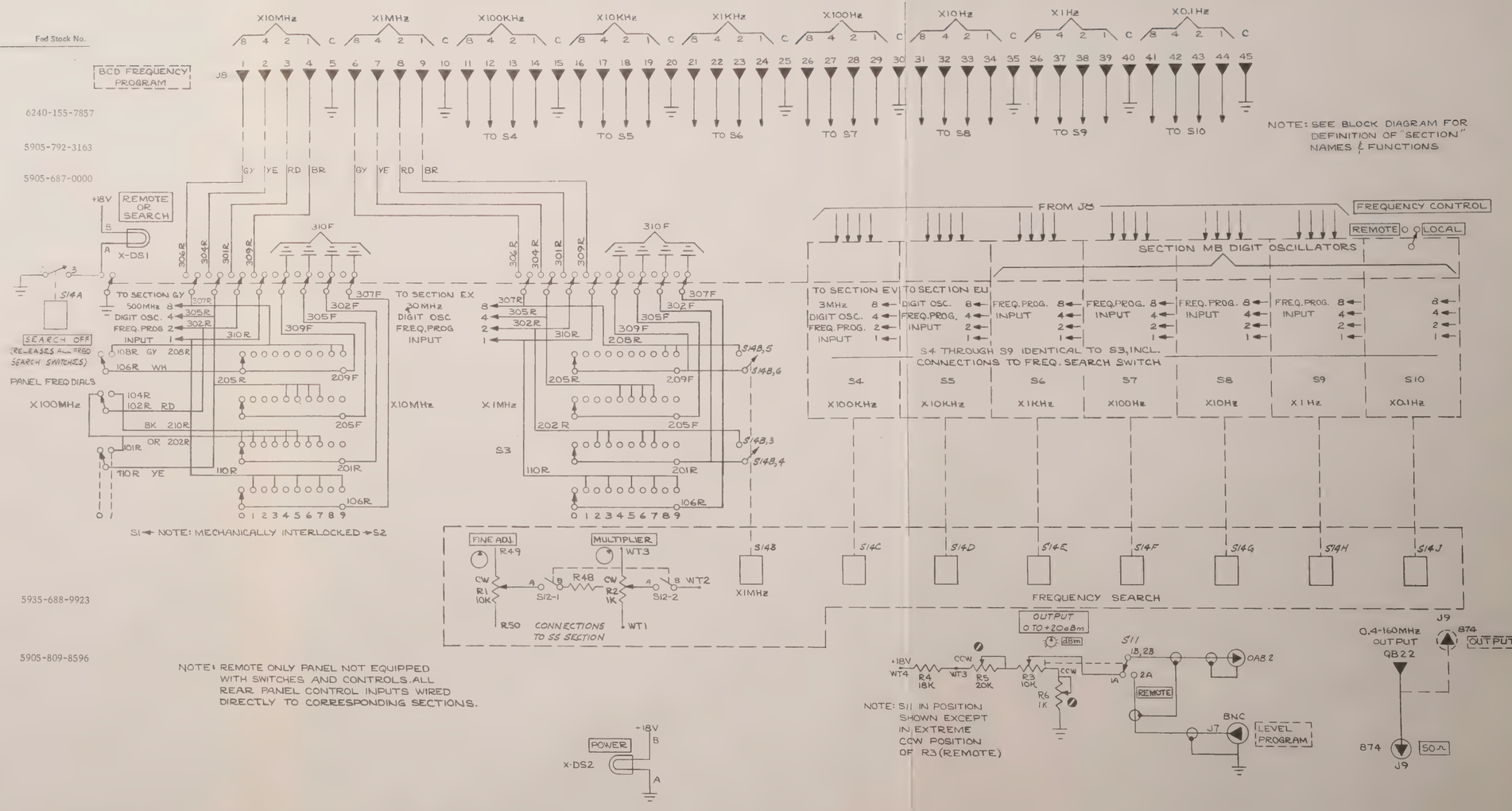
Code	Manufacturer
00192	Jones Mfg Co, Chicago, Illinois
00193	Walsco Electronics Corp, L.A., Calif
00334	Schweber Electronics, Westburg, L.I., N.Y
00656	Aerovox Corp, New Bedford, Mass
00779	Amp Inc., Harrisburg Pa., 17105
01009	Alden Products Co, Brockton, Mass
01121	Allen Bradley Co, Milwaukee, Wisc
01295	Leeds Radio Company, N.Y
01686	Litton Industries Inc, Beverly Hills, Calif
01295	Texas Instruments, Inc, Dallas, Texas
02113	Ferrocube Corp, Saugerties, N.Y. 12477
02466	Fenwal Lab Inc, Morton Grove, Ill
02660	Amphenol Electron Corp, Broadview, Ill
02768	Fastex, Des Plaines, Ill. 60016
03042	Carter Ink Co, Camb. Mass 02142
03508	G.E. Semicon Prod, Syracuse, N.Y. 13201
03635	Grayburne, Yonkers, N.Y. 10701
03888	Pyrofilm Resistor Co, Cedar Knolls, N.J
03911	Clarostat Mfg. Co. Inc., Dover, N.H. 03820
04009	Arrow-Hart & Hegeman, Hart., Conn. 06106
04404	Digitronics Corp., Albertson, N.Y. 11507
04713	Motorola, Phoenix, Ariz 85008
04810	Engr'd Electronics, Santa Ana, Calif 92702
05624	Barber-Colman Co, Rockford, Ill 61101
05748	Barnes Mfg. Co., Mansfield, O. 44901
05820	Wakefield Eng, Inc, Wakefield, Mass 01880
06383	Clevite Corp., Cleveland, O. 44110
06751	Nuclear Corp.,of America, Inc., Phoenix, Ariz
07126	Digitron Co, Pasadena, Calif.
07127	Eagle Signal (E.W. Bliss Co.), Baraboo, Wisc.
07233	Cinch-Graphik, City of Industry, Calif.
07263	Amel Corp, Culver City, Calif 90230
07363	Fairchild Camera, Mountain View, Calif.
07387	Birtcher Corp, No. Los Angeles, Calif
07695	Amer Semicond, Arlington Hts, Ill. 60004
07828	Bodine Corp, Bridgeport, Conn 06605
07829	Bodine Electric Co, Chicago, Ill. 60618
07910	Cont Device Corp, Hawthorne, Calif.
07995	State Labs Inc, N.Y., N.Y. 10003
07999	Borg Inst., Delavan, Wisc 53115
08730	Vernaline Prod Co., Franklin Lakes, N.J.
09213	G.E. Semiconductor, Buffalo, N.Y.
09408	Star-Tronics Inc, Georgetown, Mass 01830
09823	Burgess Battery Co, Freeport, Ill.
09922	Burndy Corp, Norwalk, Conn. 06852
11236	C.T.S. of Berne, Inc, Berne, Ind. 46711
11599	Chandler Evans Corp, W. Hartford, Conn.
12040	National Semiconductor, Danbury, Conn. 120
12065	Transitron Electronic Corp., E. Boston, Mass.
12498	Crystalonics, Cambridge, Mass. 02140
12617	Hamlin, Inc., Lake Mills, Wisc. 53551
12672	RCA, Woodbridge, N.J.
12697	Clarostat Mfg. Co. Inc., Dover, N.H. 03820
12954	Dickson Electronics, Scottsdale, Ariz.
13327	Solitron Devices, Tappan, N.Y. 10983
14433	ITT Semiconductors, W. Palm Beach, Fla.
14655	Cornell-Dubilier Electric Co., Newark, N.J.
14674	Corning Glass Works, Corning, N.Y.
14936	General Instrument Corp, Hicksville, N.Y.
15116	Microdot Magnetics Inc, Los Angeles, Calif.
15238	ITT, Semiconductor Div, Lawrence, Mass
15605	Cutler-Hammer Inc, Milwaukee, Wisc 53233
16037	Spruce Pine Mica Co, Spruce Pine, N.C.
16636	Indiana General Corp, Oglesby, Ill. 61348
17771	Singer Co, Diehl Div, Somerville, N.J.
17856	Siliconix, Inc., Sunnyvale, Calif. 94086
18736	Voltronics Corp, Hanover, N.J. 07936
19396	Illinois Tool Works, Pakton Div, Chicago, Ill.
19048	Computer Diode Corp, S. Fairlawn, N.J. 07410
19617	Cabtron Corp., Chicago, Ill. 60622
19644	LRC Electronics, Horseheads, N.Y.
19701	Electra Mfg Co, Independence, Kansas 67301
20754	KMC Semiconductor Corp., Long Valley, N.J. 07853
21335	Fafnir Bearing Co, New Briton, Conn.
22753	UID Electronics Corp, Hollywood, Fla.
23342	Avnet Electronics Corp, Franklin Park, Ill.
24446	G.E., Schenectady, N.Y. 12305
24454	G.E., Electronics Comp, Syracuse, N.Y.
24455	G.E. (Lamp Div.), Nela Park, Cleveland, Ohio
24655	General Radio Co, W. Concord, Mass. 01781
26806	American Zenlet Inc, Costa Mesa, Calif.
28520	Hayman Mfg Co, Kenilworth, N.J.
28959	Hoffman Electronics Corp, El Monte, Calif
30646	Beckman Instruments Inc, Cedar Grove, N.J. 07009
30874	I.B.M., Armonk, New York
32001	Jensen Mfg Co, Chicago, Ill. 60638
33173	G.E. Comp, Owensboro, Ky. 42301
34141	Koehler Mfg Co, Inc., Marlboro, Mass. 01752
35929	Constanta Co, Mont. 19, Que.
37942	P.R. Mallory & Co Inc, Indianapolis, Ind
38443	Martin-Rockwell Corp, Jamestown, N.Y.
40931	Honeywell Inc, Minneapolis, Minn 55408
42190	Muter Co, Chicago, Ill. 60638
43045	National Co, Inc, Melrose, Mass. 02176
43641	Norma-Hoffman, Stanford, Conn. 06904
44655	RCA, New York, N.Y. 10020
45964	Raytheon Mfg Co, Waltham, Mass. 02154
54921	Sangamo Electric Co, Springfield, Ill. 62705
54294	Shallcross Mfg Co, Selma, N.C.
54715	Shure Brothers, Inc, Evanston, Ill
56289	Sprague Electric Co, N. Adams, Mass
58789	Thomas and Betts Co, Elizabeth, N.J. 07207
58575	TRW Inc, (Accessories Div), Cleveland, Ohio
62399	Torrington Mfg Co, Torrington, Conn
61637	Union Carbide Corp, New York, N.Y. 10017
61864	United-Carr Fastener Corp, Boston, Mass
63060	Victoreen Instrument Co, Inc, Cleveland, O.
63743	Ward Leonard Electric Co, Mt. Vernon, N.Y.
65083	Westinghouse (Lamp Div), Bloomfield, N.J.
65092	Weston Instruments, Newark, N.J.
70485	Atlantic-India Rubber, Chicago, Ill. 60607
70563	Amperite Co, Union City, N.J. 07087
70903	Belden Mfg Co, Chicago, Ill 60644
71126	Bronson, Homer D. Co, Beacon Falls, Conn.
71279	Cambridge Thermionic Corp, Camb. Mass. 02138
71294	Canfield, H.O. Co, Clifton Forge, Va. 24422
71400	Bussman (McGraw Edison), St. Louis, Mo.
71450	CTS Corp., Elkhart Ind. 46514
71468	ITT Cannon Elec., L.S., Calif. 90031
71590	Centralab, Inc, Milwaukee, Wisc 53212
71666	Continental Carbon Co, Inc, New York, N.Y.
71729	Crescent Box Corp, E. Phila, Penn. 19134
71707	Coto Coil Co Inc, Providence, R.I.
71744	Chicago Miniature Lamp Works, Chicago, Ill.
71785	Cinch Mfg Co, Chicago, Ill. 60624
71823	Darnell Corp, Ltd, Downey, Calif 90241
72136	Electro Motive Mfg Co, Wilmington, Conn
72259	Nytronics Inc, Berkeley Heights, N.J. 07922
72619	Dialight Co, Brooklyn, N.Y. 11237
72699	General Instr Corp, Newark, N.J. 07104
72765	Drake Mfg Co, Chicago, Ill. 60656
72825	Hugh H. Eby Inc, Philadelphia, Penn. 19144
72962	Elastic Stop Nut Corp, Union, N.J. 07083
72982	Erie Technological Products Inc, Erie, Penn.
73138	Beckman Inc, Fullerton, Calif 92634
73445	Amperex Electronics Co, Hicksville, N.Y.
73559	Carling Electric Co, W. Hartford, Conn.
73690	Elco Resistor Co, New York, N.Y.
73890	JFD Electronics Corp, Brooklyn, N.Y. 11219
74193	Heinemann Electric Co, Trenton, N.J.
74868	Industrial Condenser Corp, Chicago, Ill. 60618
74970	Amphenol Corp, Danbury, Conn 06810
75042	E.F. Johnson Co, Waseca, Minn. 56093
75382	IRC Inc, Philadelphia, Penn. 19108
75491	Kulka Electric Corp, Mt. Vernon, N.Y.
75608	Lafayette Industrial Electronics, Jamaica, N.Y.
75915	Linden and Co, Providence, R.I.
76005	Littelfuse, Inc, Des Plaines, Ill. 60016
76149	Lord Mfg Co, Erie, Penn. 16512
76487	Mallory Electric Corp, Detroit, Mich. 48204
76545	James Millen Mfg Co, Malden, Mass. 02148
76684	Muetlen Electric Co, Cleveland, Ohio 44114
76854	National Tube Co, Pittsburg, Penn
77147	Oak Mfg Co, Crystal Lake, Ill
77166	Pass Seymour, Syracuse, N.Y.
77763	Perco Roberts Rubber Co, Trenton, N.J.
77939	Positive Lockwasher Co, Newark, N.J.
77342	American Machine & Foundry Co, Princton, Ind. 47570
77542	Ray-O-Vac Co, Madison, Wisc
77630	TRW, Electronic Comp, Camden, N.J. 08103
77638	General Instruments Corp, Brooklyn, N.Y.
78189	Shakeproof (Illinois Tool Works), Elgin, Ill. 60120
78277	Sigma Instruments Inc, S. Braintree, Mass
78488	Stackpole Carbon Co, St. Marys, Penn.
78553	Tinnerman Products, Inc, Cleveland, Ohio
79089	RCA, Rec Tube & Semicond, Harrison, N.J.
79275	Wenmold Co, Hartford, Conn. 06110
79963	Zierick Mfg Co, New Rochelle, N.Y.
80009	Tektronix Inc, Beaverton, Ore. 97005
80030	Prestor Fastener, Toledo, Ohio
80048	Vickers Inc, St. Louis, Mo.
80131	Electronic Industries Assn, Washington, D.C.
80183	Sprague Products Co, No. Adams, Mass
80211	Motorola Inc., Franklin Park, Ill. 60131
80258	Standard-Oil Co, Lafayette, Ind.
80294	Bourns Inc, Riverside, Calif. 92506
80368	Sylvania Electric Products Inc, N.Y. 10017
80421	Arrow-Fastener Co, Inc, Saddle Brook, N.J. 07662
80509	Allied Control Co Inc, New York, N.Y.
80583	Hamilton Co, Inc, New York, N.Y.
80640	Beckman Instruments Inc, Fullerton, Calif
80894	Prior Carbon Co, St. Marys, Penn. 15857
81030	International Instrument Corp, Conn.
81073	Grayhill Inc, LaGrange, Ill. 60525
81343	Isotron Mfg Corp, Shirley, N.J. 07980
81349	Military Specifications
81350	Military Navy Specifications
81389	Lenox Electronics, Framingham Mass. 01701
81483	International Rectifier Corp, El Segundo, Calif. 90245
81751	Columbus Electronics Corp, Yonkers, N.Y.
81831	Filtron Co, Flushing, L.I., N.Y. 11354
81840	Lindo Inc, Dayton, Ohio 45402
81860	Ilsey Weight Corp, Watertown, Mass.
82219	Sylvania Elec Prod, Emporium, Penn.
82276	Instron Pattern & Molder Works, LaPort, Ind.
82389	Switchcraft Inc, Chicago, Ill. 60630
82647	Metals & Controls Inc, Attleboro, Mass
82877	Rotron Mfg Co, Inc, Woodstock, N.Y. 12498
82877	Rotron Mfg. Co Inc, Woodstock, N.Y. 12498
83033	Midwest Mfg. Magnetic Ind, Mt. Carmel, Ill.
83058	Carr Fastener Co, Cambridge, Mass
83186	Victory Engineering, Springfield, N.J. 07081
83301	Beam-a-Scopette Co, San Francisco, Calif
83567	Solar Electric Corp, Warren, Penn.
83740	Union Carbide Corp, New York, N.Y. 10017
83781	National Electronics Inc, Geneva, Ill.
84411	TRW Capacitor Div, Ogallala, Nebr.
84625	Lenox Metal Prods, Cambridge, Mass. 02140
84971	TA-Mfg Corp, Los Angeles, Calif.
86577	Precision Metal Prods, Stoneham, Mass. 02180
86684	RCA Elect Comp & Devi, Harrison, N.J.
86687	REC Corp, New Rochelle, N.Y. 10801
86800	Cont Electronics Corp, Brooklyn, N.Y. 11222
88140	Cutler-Hammer Inc, Lincoln, Ill.
88219	Gould Nat. Batteries Inc, Trenton, N.J.
88419	Cornell Dubilier Electronics, Fuquay Varina, N.C.
88927	Kahn Mfg Co, New York, N.Y.
89482	Horton Cabot Corp, Boston, Mass.
89665	United Transformer Co, Chicago, Ill.
90201	Mallory Capacitor Co, Indianapolis, Ind.
90634	Gudeo Industries, Inc, Metuchen, N.J. 08840
90750	Westinghouse Electric Corp, Boston, Mass.
90952	Hardware Products Co, Reading, Penn. 19602
91032	Continental Wire Corp, York, Penn. 17405
91146	ITT (Cannon Electric Inc), Salem, Mass.
91210	Gerber Mfg Co, Mishawaka, Ind.
91293	Johanson Mfg Co, Boonton, N.J. 07005
91506	Augat Inc, Attleboro, Mass. 02703
91598	Chandler Co, Wethersfield, Conn. 06109
91637	Dale Electronics Inc, Columbus, Nebr.
91662	Elco Corp, Willow Grove, Penn.
91719	General Instruments, Inc, Dallas, Texas
91916	Meshato Tool Co Inc, Hudson, N.Y. 12534
91929	Honeywell Inc, Freeport, Ill.
92519	Electra Insul Corp, Woodside, L.I., N.Y.
92678	E.G.&G., Boston, Mass.
92739	Ampex Corp, Redwood City, Calif. 94063
93332	Sylvania Elect Prods, Inc, Woburn, Mass.
93618	R-S-C Mfg. Co of Penn, Inc, Ramey, Penn.
93916	Comm Products Co, Nea, Yonkers, N.Y. 10013
94144	Raytheon Co, Components Div, Quincy, Mass.
94154	Tung-Sol Electric Inc, Newark, N.J.
94271	Western Instruments Inc, Archbald, Penn. 18403
94580	Dickson Co, Chicago, Ill. 60619
94800	Atlas Industrial Corp, Brooklyn, N.H.
95076	Carde Mfg. Co., Cumberland, R.I.
95121	Quality Components Inc, St. Mary's, Penn.
95146	Alco Electronics Mfg Co, Lawrence, Mass.
95238	Continental Connector Corp, Woodside, N.Y.
95275	Vitramon, Inc, Bridgeport, Conn.
95354	Methode Mfg Co, Chicago, Ill.
95412	General Electric Co, Schenectady, N.Y.
95794	Anaconda Amer Brass Co, Torrington, Conn.
96095	H-Q Div of Aeroves Corp, Orrton, N.Y.
96214	Texas Instruments Inc, Dallas, Texas 75209
96256	Thorarson-Messner, Mt. Carmel, Ill.
96341	Microwave Associates Inc, Burlington, Mass.
96791	Amphenol Corp, Janesville, Wisc. 53545
96906	Military Standards
97684	Models Inc, North Bergen, N.J.
98291	Sealectro Corp, Mamaroneck, N.Y. 10544
98474	Comar Inc, Burlingame, Calif.
98821	North Hills Electronics Inc, Glen Cove, N.Y.
99117	Metuvac Inc, Flushing, N.Y. 11358
99180	Transitron Electronics Corp, Melrose, Mass
99313	Varian, Palo Alto, Calif. 94303
99378	Attee Corp, Winchester, Mass. 01890
99800	Delevan Electronics Corp, E. Aurora, N.Y.

ELECTRICAL PARTS LIST

Ref. Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
CHASSIS MOUNTED ELECTRICAL PARTS					
LAMP					
XD-1	28-V Pilot Light	5600-1060	24454	#328	6240-155-7857
RESISTORS					
R1	Pot. Comp., 2.5 kΩ ±10%	6000-0400	12697	53MS, 2.5 Ω ±10%	5905-792-3163
R2	Pot. Wire Wound, 1 kΩ ±10%	6060-0250	05706	1 kΩ ±10%	
R3	Pot. Comp., 10 kΩ ±10% SWK	6045-0400	01121	GA, 10 kΩ ±10%	
R4	18 K ±5%	6099-3185	75042	BTS, 18 K ±5%	5905-687-0000
R5	Pot. Cermet, 20 kΩ ±10%	6049-0299	01121	ZH 2031	
R6	Pot. W.W., 1 kΩ ±5%	6060-0232	80294	1 kΩ ±5%	
A-R50	Comp., 100 Ω ±5% 1/8 W	6098-1105	01121	BB, 100 Ω ±5%	
[illegible]					
S1	Rotary Wafer	7890-5326	76845	7890-5326	
S2	Asm	1165-2324	24655	1165-2324	
[illegible]					
[illegible]	Multiple, 9	7880-2011	24655	7880-2011	

1169-4500 10 MHz FINE STRUCTURE PACKAGE

CAPACITORS					
A-C1 and A-C2	Cer., Feed-Thru, 1000 pF +100-0%	4400-2200	01121	FA5C, 1000 pF	
A-P2 C21 thru C24	Cer., Feed-Thru, 1000 pF +100-0%	4400-2200	01121	FA5C, 1000 pF	
	Cer., Feed-Thru, 1000 pF +100-0%	4400-2200	01121	FA5C, 1000 pF	
CHOKES					
A-L3	Mult. Socket, 7 Cont.	4300-6500	99800	2150, 10 µH ±10%	
CONNECTORS					
J3 thru J6	RF Insert	1165-6020	24655	1165-6020	
A-J10	EC, 15 Pos SR	4230-2710	95354	91-6010-1201-00	5935-688-9923
A-J43	Mult. Socket, 7 Cont.	4230-5406	02660	126-198	
A-J34	Plug	4270-0975	07264	FT-M-8	
RESISTORS					
A-R50	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
SWITCHES					
A-S20	Slide, DPDT	7910-0832	82389	11A-1118	


BCD FREQUENCY PROGRAM
X10MHz X1MHz X100KHz X10KHz X1KHz X100Hz X10Hz X1Hz X0.1Hz
J8
TO S4 TO S5 TO S6 TO S7 TO S8 TO S9 TO S10
NOTE: SEE BLOCK DIAGRAM FOR DEFINITION OF "SECTION" NAMES & FUNCTIONS
+18V REMOTE OR SEARCH X-DS1
SEARCH OFF (RELEASES ALL FREQ SEARCH SWITCHES)
PANEL FREQ DIALS
TO SECTION GY
500MHz DIGIT OSC. FREQ. PROG INPUT
TO SECTION EX
30MHz DIGIT OSC FREQ. PROG INPUT
S1 NOTE: MECHANICALLY INTERLOCKED S2
FROM J8
FREQUENCY CONTROL
REMOTE LOCAL
SECTION MB DIGIT OSCILLATORS
TO SECTION EV
3MHz DIGIT OSC.
FREQ. PROG. INPUT
TO SECTION EU
FREQ.PROG. INPUT
S4 THROUGH S9 IDENTICAL TO S3, INCL. CONNECTIONS TO FREQ. SEARCH SWITCH
S4 X100KHz
S5 X10KHz
S6 X1KHz
S7 X100Hz
S8 X10Hz
S9 X1Hz
S10 X0.1Hz
FINE ADJ. R49
MULTIPLIER WT3
R50 CONNECTIONS TO S5 SECTION
WT1
FREQUENCY SEARCH
OUTPUT 0 TO +20dBm
+18V WT4 R4 18K CCW WT3 R5 20K R3 10K CCW R6 1K
NOTE: S11 IN POSITION SHOWN EXCEPT IN EXTREME CCW POSITION OF R3 (REMOTE)
REMOTE
BNC J7 LEVEL PROGRAM
0.4-160MHz OUTPUT QB22
OUTPUT
50Ω
POWER X-DS2
ROTARY SWITCH NUMBERING
WAFER SURFACE: FRONT, REAR
CONTACTS: FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01.
SECTION SECTION NEAREST PANEL IS 1
ROTORS SHOWN CCW
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

NOTE: REMOTE ONLY PANEL NOT EQUIPPED WITH SWITCHES AND CONTROLS. ALL REAR PANEL CONTROL INPUTS WIRED DIRECTLY TO CORRESPONDING SECTIONS.

Figure 6-8. Schematic diagram — panel circuit.

ELECTRICAL PARTS LIST

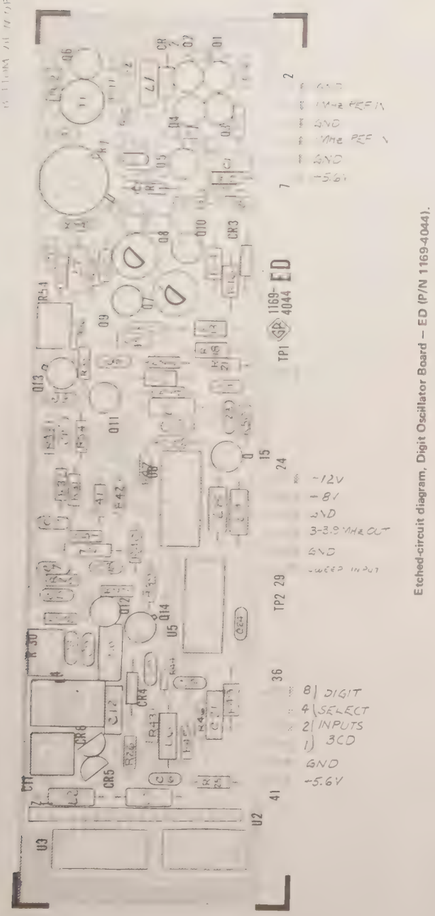
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4044 DIGIT OSCILLATOR BOARD (ED)					
CAPACITORS					
C1	Ceramic, 1.0 μF ±20% 50 V	4400-2075	80183	5C13, 1 μF ±20%	5910-083-6445
C2	Ceramic, .01 μF +80-20% 100 V	4401-3100	80131	CC61, .01 μF +80-20%	5910-974-5697
C3	Ceramic, 330 pF ±10% 500 V	4404-1335	72982	831, 330 pF ±10%	5910-974-5702
C4	Ceramic, 180 pF ±10% 500 V	4404-1185	72982	831, 180 pF ±10%	
C5	Ceramic, 560 pF ±10% 500 V	4404-1565	72982	831, 560 pF ±10%	
Ceramic					
C7	Ceramic, .01 μF +80-20% 100 V	4401-3100	80131	CC61, .01 μF +80-20%	5910-974-5697
C8	Ceramic, 24 pF ±5% 500 V N750	4417-0245	80131	CC60, 24 pF ±5%	
C9	Ceramic, 22 pF ±5% 500 V, N75	4417-0225	80131	CC60, 22 pF ±5%	
C10	Mica, 180 pF ±5% 500 V	4700-0656	14655	22A, 180 pF ±5%	5910-055-1137
C11	Trimmer, 2-8 pF, 150 V, NPO	4910-2033	72982	538-000, 2-8 pF	
C12	Ceramic, .02 μF +80-20% 100 V	4402-3200	01121	35-203W	5910-974-5698
C13 thru					
C16	Ceramic, 1000 pF ±10% 500 V	4405-2108	72982	811, 1000 pF ±10%	5910-914-0087
C17	Ceramic, 47 pF ±5% 500 V	4404-0475	72982	831, 47 pF ±5%	
C18 and					
C19	Ceramic, 1000 pF ±10% 500 V	4405-2108	72982	811, 1000 pF ±10%	5910-914-0087
C20	Ceramic, 68 pF ±5% 500 V	4404-0685	72982	831, 68 pF ±5%	
C21 and					
C22	Ceramic, .01 μF +80-20% 100 V	4401-3100	80131	CC61, .01 μF +80-20%	5910-974-5697
C23	Ceramic, 120 pF ±5% 500 V	4404-1125	72982	831, 120 pF ±5%	
C24	Ceramic, 430 pF ±5% 500 V	4700-0549	14655	22A, 430 pF ±5%	
C25 and					
C26	Ceramic, .01 μF +80-20% 100 V	4401-3100	80131	CC61, .01 μF +80-20%	5910-974-5697
CHOKES					
L1	Molded, 6.8 μH ±10%	4300-1900	99800	1537-30, 6.8 μH ±10%	
L2 and					
L3	Molded, 3.9 μH ±10%	4300-1500	99800	1537-26, 3.9 μH ±10%	
L5	Molded, 22.0 μH ±10%	4300-2600	99800	1537, 22. μH ±10%	5950-951-9266
L6	Molded, 1.0 μH ±10%	4300-0700	99800	1537, 1 μH ±10%	5950-683-7984
L7	Molded, 0.47 μH ±20%	4300-0400	99800	1537, .47 μH ±20%	5950-135-6007
L8	Molded, 18.0 μH ±10%	4300-2500	99800	1537-42, 18.0 μH ±10%	
L9	Molded, 4.7 μH ±10%	4300-1600	99800	1537-28, 4.7 μH ±10%	
DIODES					
CR1 thru					
CR4	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
CR5 and					
CR6	Type MV2111	6084-1031	17680	MV2111	
CR7	Type CA3039	6082-1044	06704	CA3039	
FERRITE BEAD					
L10 and					
L11	Ferrite Bead Misc.	5000-1250	02114	56-590-65/4B	
INDUCTOR ASM					
T1	BR	1169-2415	24655	1169-2415	
INTEGRATED CIRCUITS					
U2	Digital Type SN74L00N	5431-8300	96214	SN74L00N	
U3	Digital Type SN7445N	5431-8145	96214	SN7445N	
U5 and					
U6	Digital Type MC1032P	5431-9620	04713	MC1032P	
RESISTORS					
R1	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R2	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
R3 and					
R4	Comp., 1.2 kΩ ±5% 1/4 W	6099-2125	75042	BTS, 1.2 kΩ ±5%	
R5	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R6	Comp., 390 Ω ±5% 1/4 W	6099-1395	75042	BTS, 390 Ω ±5%	
R7	Comp., 1.8 kΩ ±5% 1/4 W	6099-2185	75042	BTS, 1.8 kΩ ±5%	5905-688-3738
R8	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R9	Comp., 15 Ω ±5% 1/4 W	6099-0155	75042	BTS, 15 Ω ±5%	
R10	Comp., 51 Ω ±5% 1/4 W	6099-0515	75042	BTS, 51 Ω ±5%	
R11 and					
R12	Film, 49.9 Ω ±1% 1/8 W	6250-9499	75042	CEA, 49.9 Ω ±1%	5905-800-7815
R13	Film, 14.7 kΩ ±1% 1/8 W	6250-2147	75042	CEA, 14.7 kΩ ±1%	5905-702-1143
R14 and					
R15	Film, 6.36 kΩ ±1% 1/8 W	6250-1636	75042	CEA, 6.36 kΩ ±1%	
R16	Film, 432 Ω ±1% 1/8 W	6250-0432	75042	CEA, 432 Ω ±1%	5905-577-7782
R17	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R18	Film, 4.99 kΩ ±1% 1/8 W	6250-1499	75042	CEA, 4.99 kΩ ±1%	
R19	Film, 10 kΩ ±1% 1/8 W	6250-2100	75042	CEA, 10 kΩ ±1%	5905-883-4847
R20	Film, 67.3 Ω ±1% 1/8 W	6250-9673	75042	CEA, 67.3 Ω ±1%	
R21	Comp., 8.2 kΩ ±5% 1/4 W	6099-2825	75042	BTS, 8.2 kΩ ±5%	
R22	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
R23	Comp., 3 kΩ ±5% 1/2 W	6100-2305	01121	BC20GF302J	5905-279-1751
R24	Comp., 330 Ω ±5% 1/4 W	6099-1335	75042	BTS, 330 Ω ±5%	5905-686-3369
R25	Comp., 12 Ω ±5% 1/4 W	6099-0125	75042	BTS, 12 Ω ±5%	5905-806-0633
R26	Comp., 33 kΩ ±5% 1/4 W	6099-3335	75042	BTS, 33 kΩ ±5%	
R27	Comp., 24 kΩ ±5% 1/4 W	6099-3245	75042	BTS, 24 kΩ ±5%	
R28	Comp., 3.9 kΩ ±5% 1/4 W	6099-2395	75042	BTS, 3.9 kΩ ±5%	
R29	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R30	Pot., Cermet 500 Ω ±20%	6049-0313	24655	6049-0313	
R31	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R32	Comp., 39 Ω ±5% 1/4 W	6099-0395	75042	BTS, 39 Ω ±5%	
R33	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
R34	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R35	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R36	Comp., 15 Ω ±5% 1/8 W	6098-0155	01121	BB, 15 Ω ±5%	
R37	Comp., 330 Ω ±5% 1/4 W	6099-1335	75042	BTS, 330 Ω ±5%	5905-686-3369
R38	Comp., 51 Ω ±5% 1/4 W	6099-0515	75042	BTS, 51 Ω ±5%	
R39	Comp., 27 Ω ±5% 1/4 W	6099-0275	75042	BTS, 27 Ω ±5%	
R40	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
R41	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R42	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R43	Comp., 180 Ω ±5% 1/4 W	6099-1185	75042	BTS, 180 Ω ±5%	5905-682-4107
R44	Comp., 15 Ω ±5% 1/8 W	6098-0155	01121	BB, 15 Ω ±5%	
R45	Comp., 3.9 kΩ ±5% 1/4 W	6099-2395	75042	BTS, 3.9 kΩ ±5%	
R46	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R47	Comp., 180 Ω ±5% 1/4 W	6099-1185	75042	BTS, 180 Ω ±5%	5905-682-4107
R48	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R49	Comp., 7.5 Ω ±5% 1/2 W	6100-9755	01121	CB, 7.5 Ω ±5%	
R50	Comp., 430 Ω ±5% 1/4 W	6099-1435	75042	BTS, 430 Ω ±5%	
R51	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
R52	Thermistor, 200 Ω ±10%	6740-1600	02606	KB22J1	
R53	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
R54	Pot. Cermet, 100 kΩ ±20%	6049-0321	24655	6049-0321	
R55	Comp., 33 kΩ ±5% 1/4 W	6099-3335	75042	BTS, 33 kΩ ±5%	
RESISTOR NETWORK					
Z1	Thin Film	1169-0810	24655	1169-0810	
TRANSFORMER ASM					
T1	BR	1169-2415	24655	1169-2415	
T2		1160-2614	24655	1160-2614	
TRANSISTORS					
Q1 and					
Q2	Type 2N4275	07263	2N4275		
Q3 thru					
Q5	Type 2N4258	8210-1136	07263	2N4258	
Q6	Type 8210-1203	8210-1203	24655	8210-1203	
Q7 and					
Q8	Type TD-400	8210-1169	23632	TD-400	
Q9 thru					
Q11	Type 2N3391A	8210-1092	24454	2N3391A	
Q12	Type 2N3563	8210-1066	07263	2N3563	
Q13 and					
Q14	Type 2N5186	8210-1189	86684	2N5186	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
CAPACITORS					
C1 thru					
C9		1165-8770	24655	1165-8770	
CHOKES					
L1	Molded, 10 μH ±10%	4300-6500	99800	2150, 10 μH ±10%	
L2	Molded, 22 μH ±10%	4300-2600	99800	1537, 22 μH ±10%	5950-951-9266
CONNECTORS					
J1 thru					
J3	RF Insert	1165-6020	24655	1165-6020	



NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

Etched-circuit diagram, Digit Oscillator Board – ED (P/N 1169-4044).

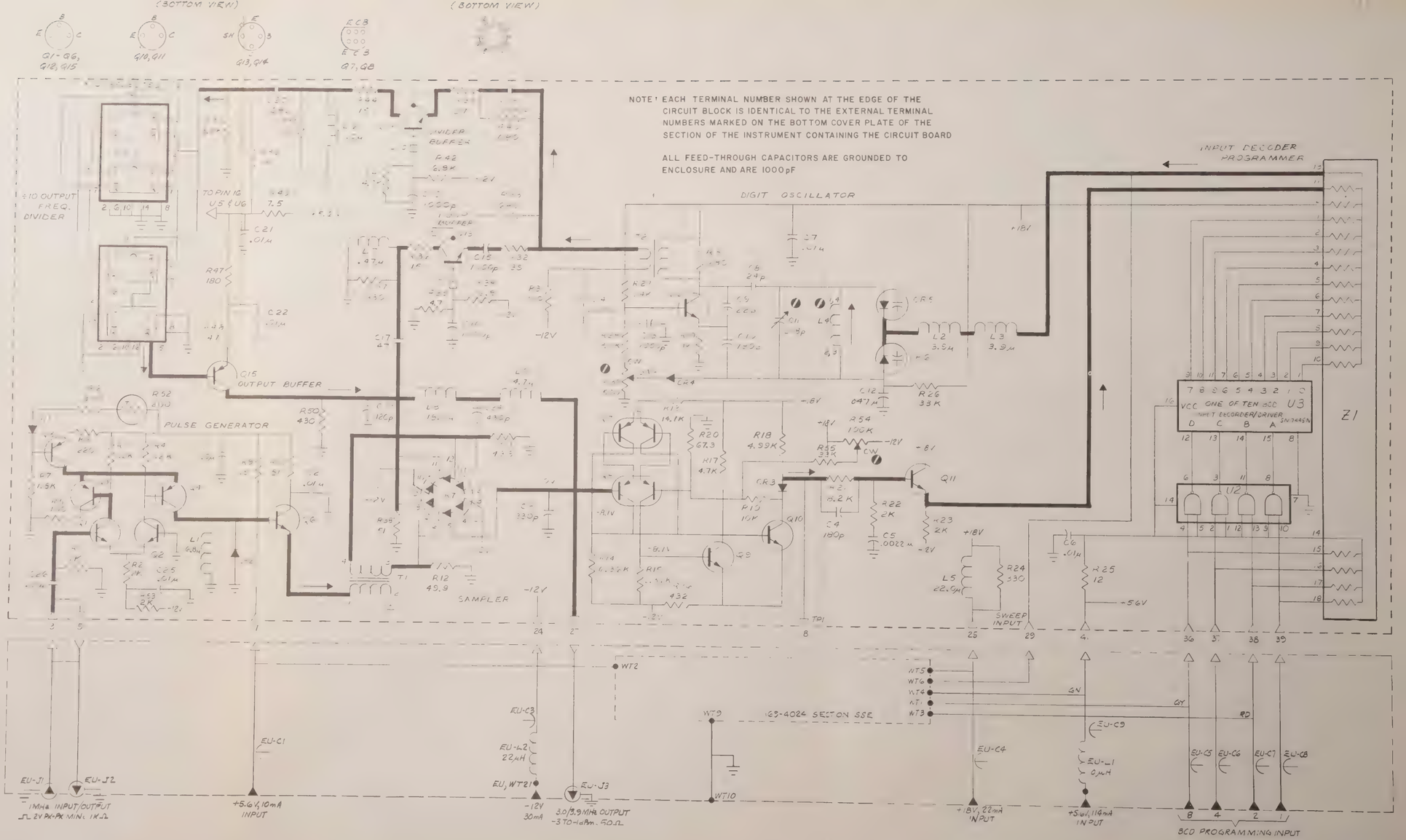


Figure 6-9. 3-MHz digit oscillator ED. (P/N 1169-4044)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4024 SEARCH/SWEEP ENABLE BOARD (SSE)					
CHOKES					
L1	Molded, 220 µH ±10%	4300-7556	72259	1025, 220 µH ±10%	
DIODES					
CR1 and CR2	Type BA136A	6082-1035	25088	BA136A	
INTEGRATED CIRCUITS					
U1	Digital Type SN74L00N	5431-8300	96214	SN74L00N	
RESISTORS					
R1	Comp., 3.3 kΩ ±5% 1/8 W	6098-2335	01121	BB, 3.3 kΩ ±5%	
R2	Comp., 2 kΩ ±5% 1/8 W	6098-2205	01121	BB, 2 kΩ ±5%	
R3	Comp., 3.3 kΩ ±5% 1/8 W	6098-2335	01121	BB, 3.3 kΩ ±5%	
R4	Comp., 56 kΩ ±5% 1/8 W	6098-3565	01121	BB, 56 kΩ ±5%	
R5	Comp., 5.6 kΩ ±5% 1/8 W	6098-2565	01121	BB, 5.6 kΩ ±5%	
R6	Comp., 750 Ω ±5% 1/4 W	6099-1755	72042	BTS, 750 Ω ±5%	
R7	Comp., 2.2 kΩ ±5% 1/8 W	6098-2225	01121	BB, 2.2 kΩ ±5%	
R8	Comp., 27 kΩ ±5% 1/8 W	6098-3275	01121	BB, 27 kΩ ±5%	
R9	Comp., 56 kΩ ±5% 1/8 W	6098-3565	01121	BB, 56 kΩ ±5%	
TRANSISTORS					
Q1 and Q2	Type 2N4125	8210-1125	04713	2N4125	
Q3	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

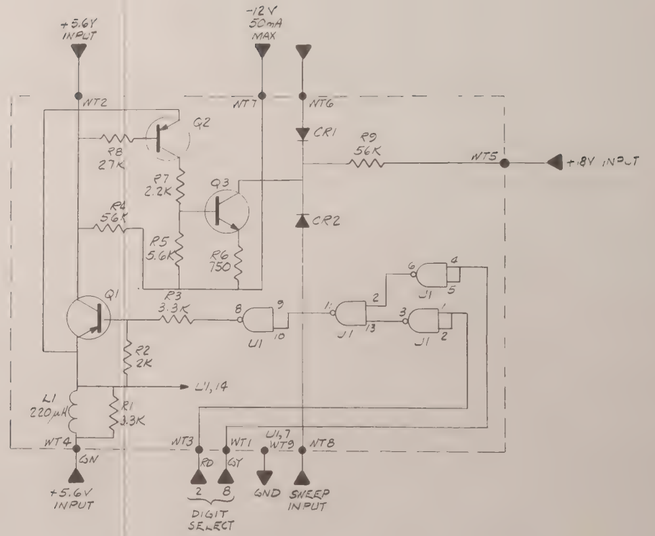


Figure 6-10. Sweep enable-circuit SSE. (P/N 1169-4024)

RESISTANCE IS IN OHMS; K=10^3, M=10^6
CAPACITANCE IS IN FARADS; μ=10^{-6}, p=10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
PANEL CONTROL, REAR CONTROL
SCREWDRIVER CONTROL, WT=WIRE TIE, TP=TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER C-R1 B R1, ETC

404F SWITCH NUMBERING
FRONT/REAR
CONTACTS, FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1
ROTORS SHOWN CCW

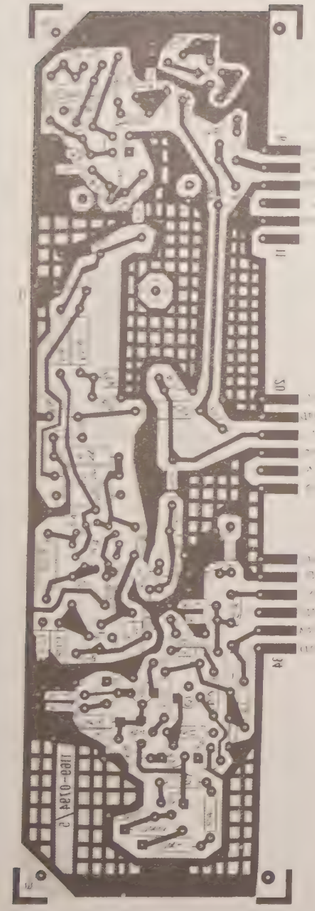
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4094 SAMPLER BOARD (EWA)					
CAPACITORS					
C1	Ceramic				
C2	Ceramic, 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C3	Ceramic, 150 pF ±10% 500 V	4404-1158	72982	831, 150 pF ±10%	
C4 thru C8	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C9	Ceramic, 120 pF ±10% 500 V	4404-1128	72982	831, 120 pF ±10%	
C10 thru C15	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C16 and C17	Ceramic, 1000 pF ±10% 500 V	4405-2108	72982	831, 1000 pF ±10%	5910-914-0087
C18 and C19	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C20	Ceramic, 56 pF ±5% 500 V	4404-0568	72982	831, 56 pF ±5%	
C21	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C22	Ceramic, 15 pF ±5% 500 V N030	4411-0155	80131	CC61, 15 pF ±5%	
C23	Ceramic, 43 pF ±5% 500 V N030	4411-0435	72982	801, 43 pF ±5%	
C24	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
CHOKES					
L1	Molded, 220 µH ±10%	4300-7556	99800	1537-28, 220 µH ±10%	
L2	Molded, 6.8 µH ±10%	4300-1900	99800	1537-28, 6.8 µH ±10%	
L3	Molded, 0.47 µH ±20%	4300-0400	99800	1537, .47 µH ±20%	5950-135-6007
L4	Molded, 4.7 µH ±10%	4300-1600	99800	1537-28, 4.7 µH ±10%	
L5	Molded, 1.8 µH ±10%	4300-1100	99800	1537, 1.8 µH ±10%	
L6	Molded, 0.47 µH ±20%	4300-0400	99800	1537, .47 µH ±20%	5950-135-6007
DIODES					
CR1 thru CR3	Type 1N3604	6092-1001	24446	1N3604	5961-995-2199
RESISTORS					
R1	Comp., 330 Ω ±5% 1/4 W	6099-1335	75042	BTS, 330 Ω ±5%	5905-686-3369
R2	Comp., 51 Ω ±5% 1/4 W	6099-0515	75042	BTS, 51 Ω ±5%	
R3	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R4	Comp., 300 Ω ±5% 1/4 W	6099-1305	75042	BTS, 300 Ω ±5%	5905-279-5481
R5	Comp., 1.8 kΩ ±5% 1/4 W	6099-2185	75042	BTS, 1.8 kΩ ±5%	5905-688-3738
R6	Comp., 20 kΩ ±5% 1/4 W	6099-3205	75042	BTS, 20 kΩ ±5%	5905-686-3368
R7	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R8	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R9 and R10	Comp., 2.0 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2.0 kΩ ±5%	5905-686-3370
R11 and R12	Comp., 1.2 kΩ ±5% 1/4 W	6099-2125	75042	BTS, 1.2 kΩ ±5%	
R13	Comp., 51 Ω ±5% 1/4 W	6099-0515	75042	BTS, 51 Ω ±5%	
R14	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R15	Comp., 15 Ω ±5% 1/4 W	6099-0155	75042	BTS, 15 Ω ±5%	
R16	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R17	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R18	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R19 and R20	Film, 49.9 kΩ ±1% 1/8 W	6250-9499	75042	CEA, 49.9 Ω ±1%	5905-800-7815
R21 and R22	Film, 1 kΩ ±1% 1/8 W	6250-1100	75042	CEA, 1 kΩ ±1%	5905-581-6915
R23	Film, 3.01 kΩ ±1% 1/8 W	6250-1301	75042	CEA, 3.01 kΩ ±1%	5905-702-5974
R24	Comp., 51 Ω ±5% 1/4 W	6099-0515	75042	BTS, 51 Ω ±5%	
R25	Film, 1 kΩ ±1% 1/8 W	6250-1100	75042	CEA, 1 kΩ ±1%	5905-581-6915
R26	Film, 6.04 kΩ ±1% 1/8 W	6250-1604	75042	CEA, 6.04 kΩ ±1%	5905-577-1790
R27 thru R29	Film, 1 kΩ ±1% 1/8 W	6250-1100	75042	CEA, 1 kΩ ±1%	5905-581-6915
R30	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R31	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
R32	Comp., 39 Ω ±5% 1/4 W	6099-0395	75042	BTS, 39 Ω ±5%	
R33	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R34	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R35	Comp., 15 Ω ±5% 1/8 W	6098-0155	01121	BB, 15 Ω ±5%	
R36	Comp., 330 Ω ±5% 1/4 W	6099-1335	75042	BTS, 330 Ω ±5%	5905-686-3369
R37	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R38	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R39	Comp., 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R40	Comp., 39 Ω ±5% 1/4 W	6099-0395	75042	BTS, 39 Ω ±5%	
R41	Comp., 5.6 kΩ ±5% 1/4 W	6099-2565	75042	BTS, 5.6 kΩ ±5%	5905-691-0195
R42	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R43	Comp., 15 Ω ±5% 1/8 W	6098-0155	01121	BB, 15 Ω ±5%	
R44	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R45	Comp., 51 Ω ±5% 1/4 W	6099-0515	75042	BTS, 51 Ω ±5%	
TRANSFORMERS					
T1	Asm (BR)	1169-2415	24655	1169-2415	
TRANSISTORS					
Q1 and Q2	Type 2N4295	8210-1126	07263	2N4275	
Q3 thru Q5	Type 2N4258	8210-1136	07263	2N4258	
Q6 and Q7	Type 8210-1203	8210-1203	24655	8210-1203	
Q8 and Q9	Type 2N5186	8210-1189	86684	2N5186	
CAPACITORS					
C1 thru C3		1165-8770	24655	1165-8770	
CONNECTORS					
J1 thru J4	RF Insert	1165-6020	24655	1165-6020	
SO1 and SO2	Contact Strip Asm	1165-1823	24655	1165-1823	
SO3	Contact Strip Asm	1165-1830	24655	1165-1830	



NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

Etched-Circuit diagram, Sampler board — EWA (P/N 1169-4094).

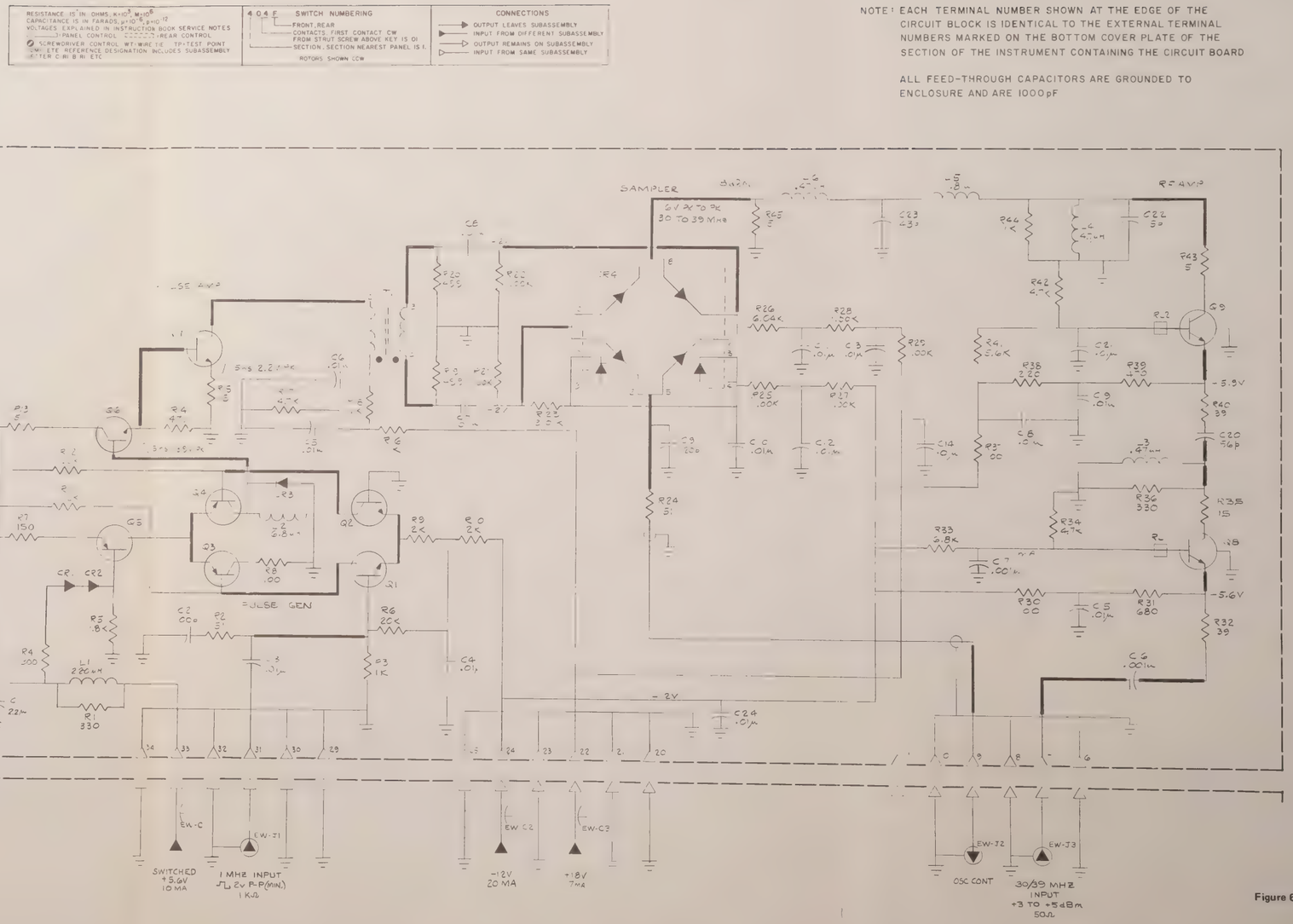

RESISTANCE IS IN OHMS, K=10³, M=10⁶
CAPACITANCE IS IN FARADS, μ=10⁻⁶, μμ=10⁻¹²
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
PANEL CONTROL
REAR CONTROL
SCREWDRIVER CONTROL WT-WIRE TIE TP-TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER C-R-I-B-N-I ETC
4 0 4 F SWITCH NUMBERING
FRONT, REAR
CONTACTS, FIRST CONTACT CW FROM STRAIT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1
ROTORS SHOWN CCW
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY
NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD
ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF
DIODE BASING (BOTTOM VIEW)
PIN #1
PIN #12
CR4
TRANSISTOR BASING (BOTTOM VIEW)
Q1,2,3,4,5,6,7
Q8,9
SAMPLER
6V PK TO 9V 30 TO 39 MHz
PULSE GEN
SWITCHED +5.6V 10 MA
1 MHz INPUT 2V P-P (MIN.) 1 KΩ
-12V 20 MA
+18V 7MA
OSC CONT
30/39 MHz INPUT +3 TO +5 dBm 50Ω
-5.9V
-5.6V
-2V

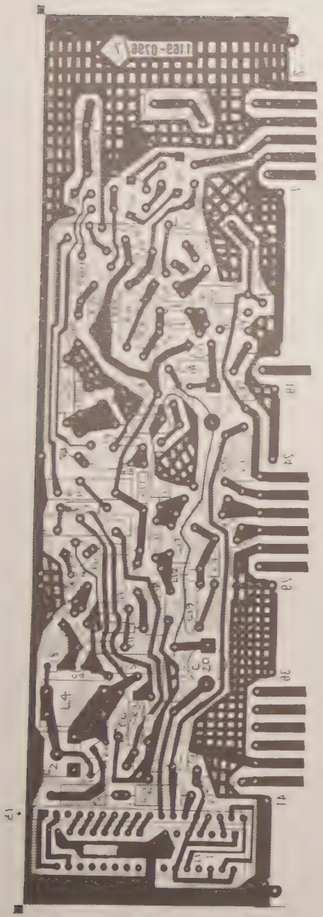
Figure 6-11. 30-MHz Digit-oscillator Sampler. (P/N 1169-4094)

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4096 OSCILLATOR BOARD (EXA)					
CAPACITORS					
C1	Ceramic, .01 μF +80-20% 100 V	4401-3100	80131	CC61, .01 μF +80-20%	5910-974-5697
C2	Trimmer, Ceramic, 2-8 pF	4910-2033	72982	538-006, 2-8 pF	
C3	Ceramic, 18 pF ±5% 100 V N150	4417-2000	72982	801, 18 pF ±5%	
C4	Ceramic, 22 pF ±5% 100 V N750	4417-2001	72982	801, 22 pF ±5%	
C5	Mica, 180 μF ±5% 500 V	4700-0650	14655	22A, 180 pF ±5%	5910-055-1137
C6	Ceramic, .02 μF +80-20% 100 V	4402-3200	01121	35-203W	5910-974-5698
C7	Ceramic, .01 μF +80-20% 100 V	4401-3100	80131	CC61, .01 μF +80-20%	5910-974-5697
C8	Ceramic, 1000 pF ±10% 500 V	4405-2108	72982	801, .001 μF ±10%	5910-914-0087
C9 and C10	Ceramic, .01 μF +80-20% 100 V	4401-3100	80131	CC61, .01 μF +80-20%	5910-974-5697
C11 and C12	Ceramic, 15 pF ±5% 500 V N030	4411-0155	72982	801, 15 pF ±5%	
C13 and C14	Ceramic, 43 pF ±5% 500 V N030	4411-0435	72982	801, 43 pF ±5%	
C15	Ceramic, 82 pF ±5% 500 V N220	4414-1200	72982	0855037R2G00820J	
C17	Ceramic, 10 pF ±5% 500 V N030	4411-0105	72982	801, 10 pF ±5%	
C18	Mica, 130 pF ±5% 500 V	4700-0439	14655	22A, 130 pF ±5%	
C19	Ceramic, 75 pF ±5% 500 V N030	4411-0753	72982	801, 75 pF ±5%	
C20 and C21	Trimmer, Ceramic, 5.5-18 pF	4910-2044	72982	538-002, 5.5 to 18 pF	
C22	Ceramic, 27 pF ±5% 100 V N750	4417-2002	80131	CC62, 27 pF ±5%	
C23	Ceramic, 180 pF ±10% 500 V	4404-1188	72982	831, 180 pF ±10%	
C24	Ceramic, 1000 pF ±10% 500 V	4405-2108	72982	801, .001 pF ±10%	5910-914-0087
C25	Ceramic, 150 pF ±5% 500 V	4404-1155	72982	831, 150 pF ±5%	5910-952-8403
C26	Tantalum, 3.3 μF ±20% 15 V	4450-4600	56289	150D335X0015A2	5910-837-9325
CHOKES					
L1	Molded, 22 μH ±10%	4300-2600	99800	1537, 22 μH ±10%	5950-951-9266
L2 and L3	Molded, 3.9 μH ±10%	4300-1500	99800	1537-26, 3.9 μH ±10%	
L4	Asm (RD)	1169-2412	24655	1169-2412	
L5 and L6	Molded, 4.7 μH ±10%	4300-1600	99800	1537-28, 4.7 μH ±10%	
L7	Molded, 1.8 μH ±10%	4300-1100	99800	1537, 1.8 μH ±20%	
L8	Molded, 0.47 μH ±20%	4300-0400	99800	1537, 47 μH ±20%	5950-135-6007
L9	Molded, 1.8 μH ±10%	4300-1100	99800	1537, 1.8 μH ±20%	
L10	Molded, 0.47 μH ±20%	4300-0400	99800	1537, 47 μH ±20%	5950-135-6007
L11 and L12	Molded, 0.22 μH ±10%	4300-7551	72259	1025, 0.22 μH ±10%	
L13	Shielded, 470 μH ±10%	4300-6367	99800	3500, 470 μH ±10%	
L14	Shielded, 680 μH ±10%	4300-6386	99800	1537-742, 680 μH ±10%	
DIODES					
CR1 and CR2	MV2111	6084-1031	17680	MV2111	
CR3 and CR4	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
FERRITE					
LR1 and LR2	Bead	5000-1250	02114	56-590-65/4B	
INDUCTORS					
L4	Asm (RD)	1169-2412	24655	1169-2412	
INTEGRATED CIRCUITS					
U1	Digital, Type SN74L00N	5431-8300	96214	SN74L00N	
U2	Digital, Type SN7445N	5431-8145	96214	SN7445N	
RESISTORS					
R1	Comp., 12 Ω ±5% 1/4 W	6099-0125	75042	BTS, 12 Ω ±5%	5905-806-0633
R2	Comp., 300 Ω ±5% 1/4 W	6099-1305	75042	BTS, 300 Ω ±5%	5905-279-5481
R3	Comp., 18 Ω ±5% 1/4 W	6099-0185	75042	BTS, 18 Ω ±5%	
R4	Comp., 300 Ω ±5% 1/4 W	6099-1305	75042	BTS, 300 Ω ±5%	5905-279-5481
R5	Comp., 330 Ω ±5% 1/4 W	6099-1335	75042	BTS, 330 Ω ±5%	5905-686-3369

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R6	Comp., 20 kΩ ±5% 1/4 W	6099-3205	75042	BTS, 20 kΩ ±5%	5905-686-3368
R7	Pot., Wirewound 2 kΩ ±10%	6051-2209	07989	2600PC, 2 kΩ ±10%	
R8	Comp., 510 Ω ±5% 1/4 W	6099-1515	75042	BTS, 510 Ω ±5%	5905-801-8272
R9	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R10	Pot. Wirewound, 10 kΩ ±10%	6051-3109	02660	2600PC, 10 kΩ ±10%	
R11	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R12	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R13	Comp., 20 kΩ ±5% 1/4 W	6099-3205	75042	BTS, 20 kΩ ±5%	5905-686-3368
R14	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R15	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R16	Comp., 51 Ω ±5% 1/4 W	6098-0515	01121	BB, 51 Ω ±5%	
R17	Comp., 1.3 kΩ ±5% 1/4 W	6099-2135	75042	BTS, 1.3 kΩ ±5%	5905-686-3119
R18	Comp., 30 Ω ±5% 1/4 W	6099-0305	75042	BTS, 30 Ω ±5%	
R19	Comp., 1.3 kΩ ±5% 1/4 W	6099-2135	75042	BTS, 1.3 kΩ ±5%	5905-686-3119
R20	Comp., 30 Ω ±5% 1/4 W	6099-0305	75042	BTS, 30 Ω ±5%	
R21 and R22	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R23	Comp., 330 Ω ±5% 1/4 W	6099-1335	75042	BTS, 330 Ω ±5%	5905-686-3369
R24	Film, 14.7 kΩ ±1% 1/8 W	6250-2147	75042	CEA, 14.7 kΩ ±1%	5905-702-1143
R25 and R26	Film, 6.36 kΩ ±1% 1/8 W	6250-1636	75042	CEA, 6.36 kΩ ±1%	
R27	Pot. Cermet, 100 kΩ ±10%	6049-0192	24655	6049-0192	
R28	Comp., 33 kΩ ±5% 1/4 W	6099-3335	75042	BTS, 33 kΩ ±5%	
R29	Film, 432 Ω ±1% 1/8 W	6250-0432	75042	CEA, 432 Ω ±1%	5905-571-1782
R30	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R31	Film, 10.0 kΩ ±1% 1/8 W	6250-2100	75042	CEA, 10.0 kΩ ±1%	5905-883-4847
R32	Film, 432 Ω ±1% 1/8 W	6250-0432	75042	CEA, 432 Ω ±1%	5905-571-1782
R33	Film, 4.99 kΩ ±1% 1/8 W	6250-1499	75042	CEA, 4.99 kΩ ±1%	
R34	Comp., 8.2 kΩ ±5% 1/4 W	6099-2825	75042	BTS, 8.2 kΩ ±5%	
R35	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
TRANSISTORS					
Q1	Type 2N3563	8210-1066	07263	2N3563	
Q2 thru Q4	Type 2N4258	8210-1136	07263	2N4258	
Q5 and Q6	Type TD-400	8210-1169	80183	TD-400	
Q7 thru Q9	Type 3N3391A	8210-1092	24454	2N3391A	



Etched-circuit diagram, Digit Oscillator board – EXA (P/N 1169-4096).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

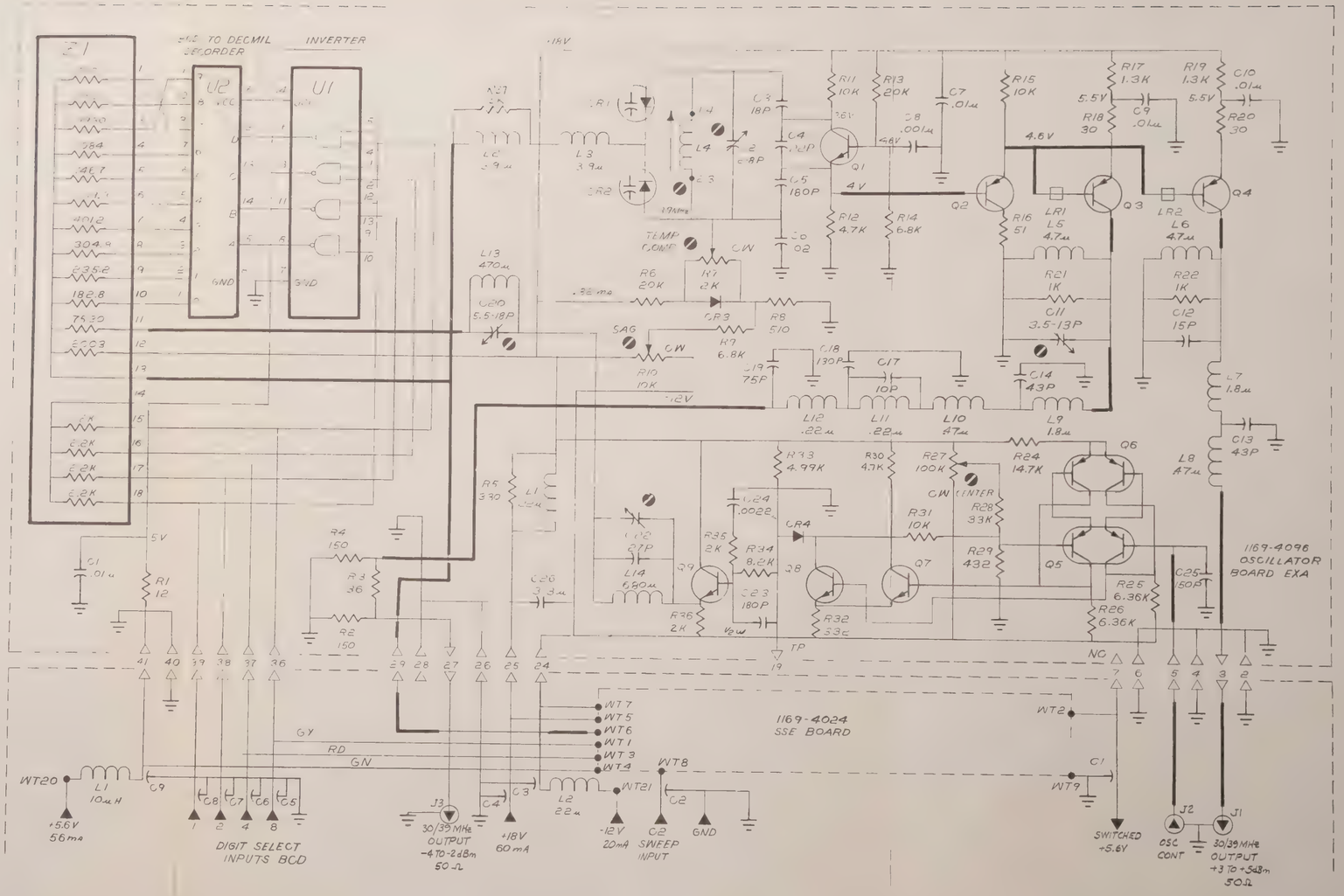


Figure 6-12. 30 MHz digit oscillator. (P/N 1169-4096)

ELECTRICAL PARTS LIST

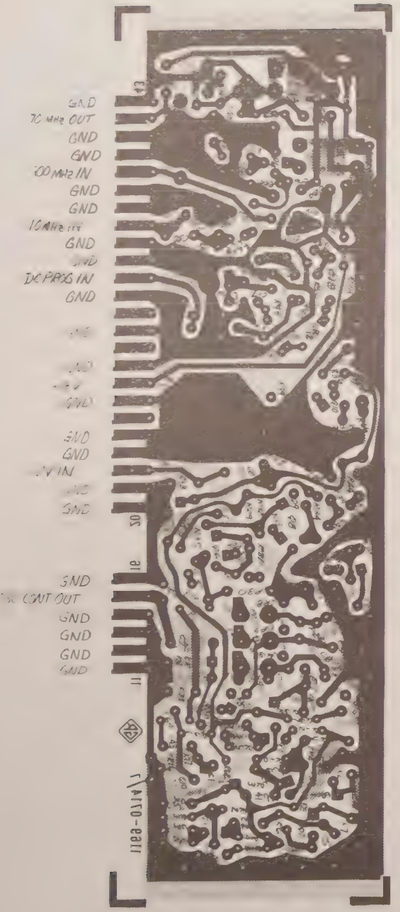
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4014 PROGRAM CIRCUIT BOARD (GD)					
CAPACITORS					
C1	Ceramic, 33 pF ±5% 500 V, N030	4411-0335	80131	CC62, 33 pF ±5%	
C2	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C3	Ceramic, 680 pF ±5% 500 V	4404-1685	72982	831, 680 pF ±10%	5910-852-8642
C4	Ceramic, 0.22 µF ±20% 25 V	4400-2052	80183	5C13, .22 µF ±20%	5910-974-5694
C5	Ceramic, .05 µF +80-20% 100 V	4403-3500	01121	40-503W	5910-883-7321
C6	Ceramic, 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
C7	Ceramic, .022 µF ±10% 50 V	4400-6353	72982	8131-050-W5R-224K	
C8	Ceramic, 0.22 µF ±20% 25 V	4400-2052	80183	5C13, .22 µF ±20%	5910-974-5694
C9	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C10	Ceramic, 1 µF ±20% 25 V	4400-2070	80183	5C13, .1 µF ±20%	5910-083-6445
C12	Ceramic, 9.1 pF ±5% 500 V N030	4411-9915	80131	CC60, 9.1 pF ±5%	
C13 and C14	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C15	Ceramic, 8.2 pF ±5% 500 V N030	4411-9825	80131	CC60, 8.2 pF ±5%	
C16 thru C18	Ceramic, 150 pF ±5% 200 V	4400-6254	72982	855, 150 pF ±5%	
C19	Ceramic, 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
C20	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C21	Ceramic, 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
C22	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C24	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C25	Ceramic, 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
C27 thru C32	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C33	Ceramic, 33 pF ±5% 500 V NPO	4410-0335	80131	CC61, 33 pF ±5%	
C34 and C35	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C36	Ceramic, 5.1 pF ±5% 500 V N030	4411-9515	80131	CC60, 5.1 pF ±5%	
C37 and C38	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C39	Ceramic, 2.2 µF ±20% 50 V	4400-6420	72982	8141-050-651-225M	
C40	Ceramic, 2.7 pF ±5% 500 V N030	4411-9275	80131	CC60, 2.7 pF ±5%	
C41	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C42	Ceramic, 2.2 µF ±20% 50 V	4400-6420	72982	8141-050-651-225M	
C43	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C44	Ceramic, 20 pF ±5% 500 V NPO	4410-0205	80131	CC61, 20 pF ±5%	
C90	Ceramic, 2.2 pF ±0.25 pF 500 V NPO	4400-2450	72982	5C13, 2.2 pF ±.2%	
CHOKES					
L2	Molded, 3.9 µH ±10%	4300-7526	99800	1025	
L3 and L4	Molded, 12.0 µH ±10%	4300-7525	99800	1025	
DIODES					
CR1 and CR2	Type 1N35(s)	6082-1004	58854	1N35(s)	
CR3	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
CR4	Type 1N965B	6083-1015	07910	1N965B	5960-877-6192
CR5	Type BA136A	6082-1035	25088	BA136A	
CR6 thru CR9	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
CR10 thru CR13	Type MSQ100S2	6082-1023	13327	MSQ100520	
CR14	Type M0271J	6084-1027	05621	M0271J	
CR15	Type 1N2166A	6083-1011	07595	1N2166A	
CR16 thru CR18	Type 1N34A(s)	6082-1003	58854	1N34A(s)	5961-170-4430
CR19	Type 1N750A	6083-1028	07910	1N750A	5960-754-5897
RESISTORS					
R1	Comp., 5.1 kΩ ±5% 1/8 W	6098-2515	01121	BB, 5.1 kΩ ±5%	
R2	Comp., 330 kΩ ±5% 1/8 W	6098-4335	01121	BB, 330 kΩ ±5%	
R3	Comp., 150 kΩ ±5% 1/8 W	6098-4155	01121	BB, 150 kΩ ±5%	
R4	Comp., 1.6 kΩ ±5% 1/8 W	6098-2165	01121	BB, 1.6 kΩ ±5%	
R5	Comp., 430 Ω ±5% 1/8 W	6098-1435	01121	BB, 430 Ω ±5%	
R6	Comp., 39 kΩ ±5% 1/8 W	6098-3395	01121	BB, 39 kΩ ±5%	

MECHANICAL PARTS LIST (cont)

Fig Ref	Qnt	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)						
R7		Comp., 5.1 kΩ ±5% 1/8 W	6098-2515	01121	BB, 5.1 kΩ ±5%	
R8		Comp., 1 kΩ ±5% 1/8 W	6098-2105	01121	BB, 1 kΩ ±5%	
R9		Comp., 100 Ω ±5% 1/8 W	6098-1105	01121	BB, 100 Ω ±5%	
R10		Comp., 33 kΩ ±5% 1/8 W	6098-3335	01121	BB, 33 kΩ ±5%	
R11		Comp., 300 Ω ±5% 1/4 W	6099-1305	75042	BTS, 300 Ω ±5%	5905-279-5481
R12		Comp., 680 Ω ±5% 1/8 W	6098-1685	01121	BB, 680 Ω ±5%	
R13		Comp., 1 kΩ ±5% 1/8 W	6098-2105	01121	BB, 1 kΩ ±5%	
R14		Comp., 4.7 Ω ±5% 1/8 W	6098-9475	01121	BB, 4.7 Ω ±5%	
R15		Comp., 10 Ω ±5% 1/8 W	6098-0105	01121	BB, 100 Ω ±5%	
R16		Comp., 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R17		Pot. Cermet, 500 Ω ±10% 0.5 W	6049-0214	01121	SV5011	
R19		Pot. Cermet, 2 kΩ ±10% 0.5 W	6049-0216	01121	SV2021	
R20		Comp., 820 Ω ±5% 1/4 W	6099-1825	75042	BTS, 820 Ω ±5%	
R21		Comp., 2.2 kΩ ±5% 1/8 W	6098-2225	01121	BB, 2.2 kΩ ±5%	
R22		Comp., 390 Ω ±5% 1/4 W	6099-1395	75042	BTS, 390 Ω ±5%	
R23		Comp., 4.7 kΩ ±5% 1/8 W	6098-2475	01121	BB, 4.7 kΩ ±5%	
R24		Pot. Cermet, 500 Ω ±10% 0.5 W	6049-0214	01121	SV5011	
R25		Comp., 3.3 kΩ ±5% 1/8 W	6098-2335	01121	BB, 3.3 kΩ ±5%	
R26		Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R27*		Comp., 3.0 kΩ ±5% 1/4 W	6099-2305	01121	BB, 3.0 kΩ ±5%	
R28		Comp., 10 Ω ±5% 1/4 W	6099-0105	01121	BB, 10 Ω ±5%	5905-809-8596
R29		Comp., 3.3 kΩ ±5% 1/4 W	6099-2335	75042	BTS, 3.3 kΩ ±5%	5905-681-9969
R30		Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R31		Comp., 200 Ω ±5% 1/4 W	6099-1205	75042	BTS, 200 Ω ±5%	5905-683-2239
R32 and R33		Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R34		Comp., 18 kΩ ±5% 1/4 W	6099-3185	75042	BTS, 18 kΩ ±5%	5905-687-0000
R35		Comp., 2 kΩ ±5% 1/2 W	6100-2205	01121	RC20GF202J	5905-190-8887
R36		Pot. Cermet, 20 kΩ ±10%	6049-0279	01121	SV2031	
R37		Comp., 1.3 MΩ ±5% 1/4 W	6099-5135	75042	BTS, 1.3 MΩ ±5%	
R38		Comp., 24 kΩ ±5% 1/4 W	6099-3245	75042	BTS, 24 kΩ ±5%	
R39		Comp., 1.3 MΩ ±5% 1/4 W	6099-5135	75042	BTS, 1.3 MΩ ±5%	
R40		Comp., 510 Ω ±5% 1/4 W	6099-1515	75042	BTS, 510 Ω ±5%	5905-801-8272
R41		Film, 1.21 kΩ ±1% 1/8 W	6250-1121	75042	CEA, 1.21 kΩ ±5%	
R42		Comp. 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R43		Comp., 13 kΩ ±5% 1/4 W	6099-3135	75042	BTS, 13 kΩ ±5%	5905-702-4439
R44		Pot. Cermet, 5 kΩ ±10% 0.5 W	6049-0217	01121	SV5021	
R48 and R49		Comp., 100 Ω ±5% 1/8 W	6098-1105	01121	BB, 100 Ω ±5%	
R50		Pot. Cermet, 200 Ω ±10%	6049-0273	01121	SV2011	
R51		Comp., 51 Ω ±5% 1/4 W	6099-0515	75042	BTS, 51 Ω ±5%	
R52		Comp., 300 Ω ±5% 1/4 W	6099-1305	75042	BTS, 300 Ω ±5%	5905-279-5481
R53		Comp., 150 Ω ±5% 1/4 W	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
R54		Comp., 2 kΩ ±5% 1/8 W	6098-2205	01121	BB, 2 kΩ ±5%	
R55		Comp., 1.8 kΩ ±5% 1/8 W	6098-2185	01121	BB, 1.8 kΩ ±5%	
R56		Comp., 8.2 kΩ ±5% 1/8 W	6098-2825	01121	BB, 8.2 kΩ ±5%	
R57		Comp., 10 Ω ±5% 1/8 W	6098-0105	01121	BB, 100 Ω ±5%	
R58		Comp., 1.8 kΩ ±5% 1/8 W	6098-2185	01121	BB, 1.8 kΩ ±5%	
R59		Comp., 8.2 kΩ ±5% 1/8 W	6098-2825	01121	BB, 8.2 kΩ ±5%	
R60		Comp., 470 Ω ±5% 1/8 W	6098-1475	01121	BB, 470 Ω ±5%	
R61		Comp., 10 Ω ±5% 1/8 W	6098-0105	01121	BB, 100 Ω ±5%	
R62		Comp., 22 Ω ±5% 1/8 W	6098-0225	01121	BB, 22 Ω ±5%	
R63		Comp., 10 Ω ±5% 1/8 W	6098-0105	01121	BB, 100 Ω ±5%	
R64		Comp., 3.9 kΩ ±5% 1/8 W	6098-2395	01121	BB, 3.9 kΩ ±5%	
R65		Pot. Cermet, 200 Ω ±10%	6049-0273	01121	SV2011	
R66		Comp., 560 Ω ±5% 1/4 W	6099-1565	75042	BTS, 560 Ω ±5%	
R67		Comp., 10 kΩ ±5% 1/8 W	6098-3105	01121	BB, 10 kΩ ±5%	
R68		Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R70		Comp., 18 Ω ±5% 1/8 W	6098-0185	01121	BB, 18 Ω ±5%	
R71		Comp., 120 Ω ±5% 1/8 W	6098-1125	01121	BB, 120 Ω ±5%	
R72		Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
TRANSISTORS					
Q1 and Q2	Type 2N3903	8210-1132	04713	2N3903	
Q3	Type 2N3906	8210-1112	04713	2N3906	
Q5	Type 2N3903	8210-1132	04713	2N3903	
Q6	Type 2N3563	8210-1066	07263	2N3563	
Q7	Type 2N3903	8210-1132	04713	2N3903	
Q8 and Q9	Type 1165-2990	1165-2990	24655	1165-2990	
Q10	Type 2N5249	8210-1077	24454	2N5249	
Q11	Type 2N3903	8210-1132	04713	2N3903	
Q14 and Q15	Type 2N3478	8210-1111	79089	2N3478	
TRANSFORMERS					
T1	Asm.	1165-2240	24655	1165-2240	

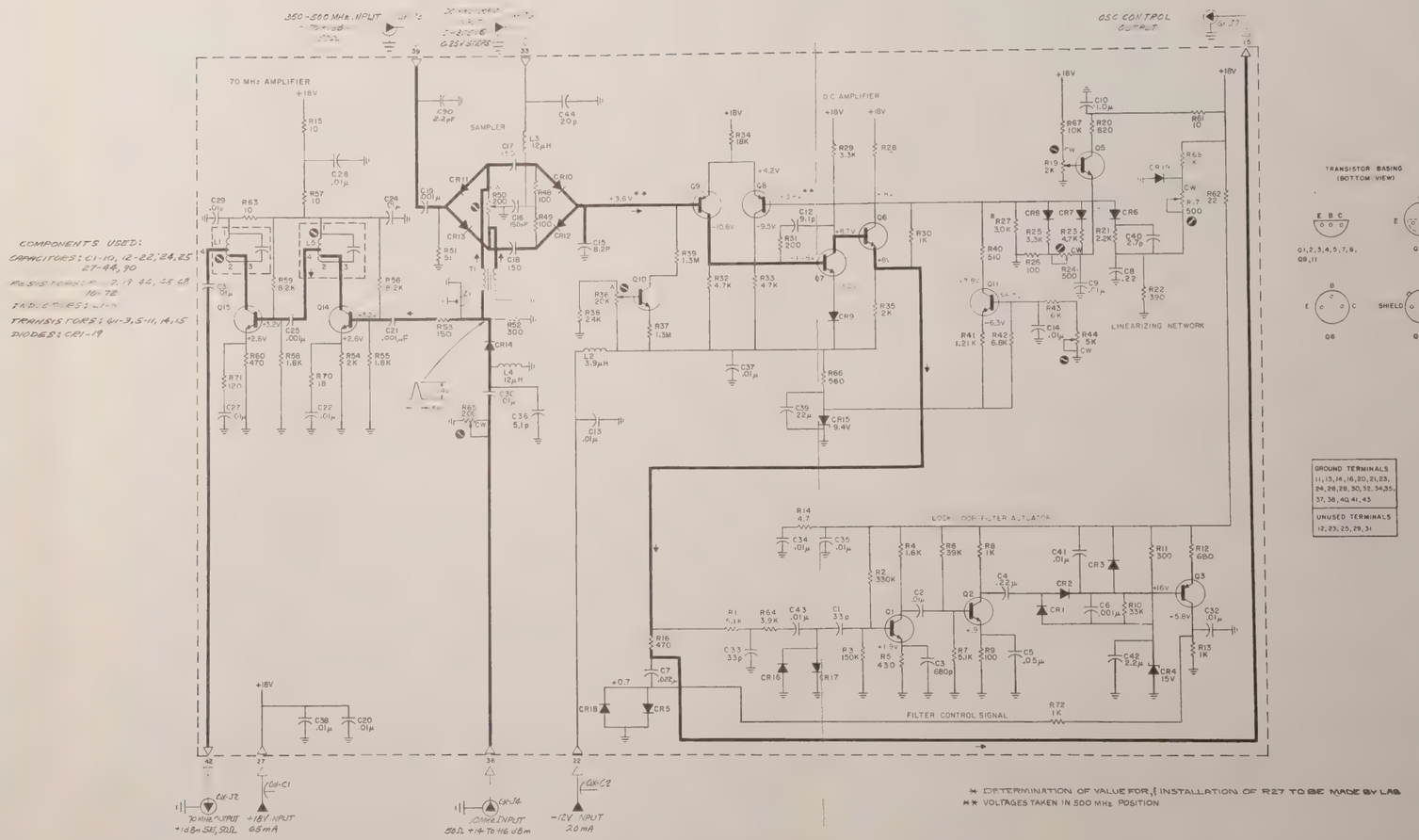


Etched-circuit diagram, Sampler Circuit board – GD (P/N 1169-4014).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF



GROUND TERMINALS
11, 13, 14, 16, 20, 21, 23, 24, 26, 28, 30, 32, 34, 35, 37, 38, 40, 41, 43
UNUSED TERMINALS
12, 23, 25, 29, 31

* DETERMINATION OF VALUE FOR, & INSTALLATION OF R27 TO BE MADE BY LAB

** VOLTAGES TAKEN IN 500 MHz POSITION

RESISTANCE IS IN OHMS, K = 10^3, M = 10^6
CAPACITANCE IS IN FARADS, μ = 10^{-6}, p = 10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
FRONT PANEL CONTROL ○ REAR CONTROL
SCREWDRIVER CONTROL INT WIRE TIE TP TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER (A1, A1, ETC.

4 3 2 1 F ROTARY SWITCH NUMBERING
WAFER SURFACE FRONT, REAR
CONTACTS FIRST CONTACT CW FROM STRAIT SCREW ABOVE KEY IS 01
SECTION SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW

CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

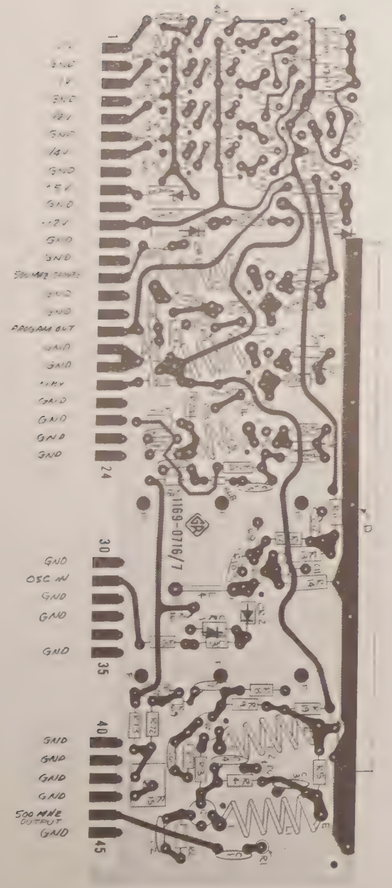
Figure 6-13. 500-MHz Digit Oscillator Sampler – GD. (P/N 1169-4014)

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4016 OSCILLATOR CIRCUIT ASM (GE)					
CAPACITORS					
C1 thru C7	Ceramic, 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
C9	Ceramic, 8.2 pF ±5% 500 V N030	4411-9825	80131	CC60, 8.2 pF ±5%	
C10	Ceramic, 1.2 pF ±5% 500 V	4400-0120	78488	GA, 1.2 pF ±5%	
C11 thru C13	Ceramic, 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
C14	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C15 thru C17	Ceramic, 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
C18	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C19 thru C22	Ceramic, 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
C23	Ceramic, 5.1 pF ±5% 100 V NPO	4410-1201	09376	5.1 pF ±5%	
C25	Ceramic, 10 pF ±5% 500 V N030	4411-0105	80131	CC60, 10 pF ±5%	
C26 and C27	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
CHOKES					
L3	0.39 µH ±10%	4300-7523	99800	1537, 39 µH ±10%	
CONNECTORS					
XCR1, and XCR2	Jack	4260-1293	07047	90203-2	
FERRITE BEAD					
L8		5000-1250	02114	56-590-651B	
RESISTORS					
R2	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
R3	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R4	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R5	Comp., 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R6	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R7	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R8	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R9	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R11	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R12	Film, 1.40 kΩ ±1% 1/8 W	6250-1140	75042	CEA, 1.40 kΩ ±1%	
R13	Film, 3.48 kΩ ±1% 1/8 W	6250-1348	75042	CEA, 3.48 kΩ ±1%	5905-686-3385
R14	Film, 7.5 kΩ ±1% 1/8 W	6250-1750	75042	CEA, 7.5 kΩ ±1%	5905-660-4129
R15	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R16	Comp., 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R17	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R18	Comp., 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R19	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R20	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R21	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R22	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R23	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R24	Comp., 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R25	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R26	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R27	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R28	Comp., 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R29	Comp., 56 Ω ±5% 1/4 W	6099-0565	75042	BTS, 56 Ω ±5%	
R30	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R31	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R32	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R33	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
R34	Comp., 75 Ω ±5% 1/4 W	6099-0755	75042	BTS, 75 Ω ±5%	
R35 thru R38	Comp., 5.1 kΩ ±5% 1/4 W	6099-2515	75042	BTS, 5.1 kΩ ±5%	5905-683-2241
R39 thru R42	Comp., 12 kΩ ±5% 1/8 W	6098-3125	01121	BB, 12 kΩ ±5%	
R43	Pot Comp., 5 kΩ ±10%	6049-0217	01121	SV5021	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R44	Pot Comp., 2 kΩ ±10%	6049-0216	01121	SV2021	
R45	Pot Comp., 1 kΩ ±10%	6049-0215	01121	SV1021	
R46	Pot Comp., 500 Ω ±10%	6049-0214	01121	SV5011	
R47	Film, 33.2 kΩ ±1% 1/8 W	6250-2332	75042	CEA, 33.2 kΩ ±1%	5905-681-8758
R48	Film, 8.66 kΩ ±1% 1/8 W	6250-2169	75042	CEA, 16.9 kΩ ±1%	5905-806-8487
R49	Film, 8.66 kΩ ±1% 1/8 W	6250-1866	75042	CEA, 8.66 kΩ ±1%	5905-755-8130
R50	Film, 4.32 kΩ ±1% 1/8 W	6250-1432	75042	CEA, 4.32 kΩ ±1%	
R51	Film, 3.24 kΩ ±1% 1/8 W	6250-1324	75042	CEA, 3.24 kΩ ±1%	
R52	Pot Comp., 500 Ω ±10%	6049-0214	01121	SV5011	
R53	Comp., 360 Ω ±5% 1/4 W	6099-1365	75042	BTS, 360 Ω ±5%	
R54	Film, 1 kΩ ±1% 1/8 W	6250-1100	75042	CEA, 1 kΩ ±1%	5905-581-6915
R55	Comp., 510 Ω ±5% 1/2 W	6100-1515	01121	RC20GF511J	5905-279-3511
R56	Comp., 3.3 kΩ ±5% 1/4 W	6099-2335	75042	BTS, 3.3 kΩ ±5%	5905-681-9969
R57 thru R64	Comp., 12 kΩ ±5% 1/8 W	6098-3125	01121	BB, 12 kΩ ±5%	
R68 and R69	Comp., 22 Ω ±5% 1/8 W	6098-0225	01121	BB, 22 Ω ±5%	
R70 and R71	Comp., 4.7 Ω ±5% 1/8 W	6098-9475	01121	BB, 4.7 Ω ±5%	
R72 and R73	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R75	Pot Cermet, 1 kΩ ±10%	6049-0275	01121	SV5021	
TRAY ASM					
CAPACITORS					
C1 thru C7		1165-8770	24655	1165-8770	
CONNECTORS					
J1 thru J4	RF Insert	1165-6020	24655	1165-6020	
SO1	Contact Strip Asm	1165-1812	24655	1165-1812	
SO2	Contact Strip Asm	1165-1820	24655	1165-1820	
SO3	Contact Strip Asm	1165-1811	24655	1165-1811	
SO4	Contact Strip Asm	1165-1820	24655	1165-1820	
SO5 and SO6	Contact Strip Asm	1165-1831	24655	1165-1831	



Etched-circuit diagram, Oscillator Circuit board – GE (P/N 1169-4016).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

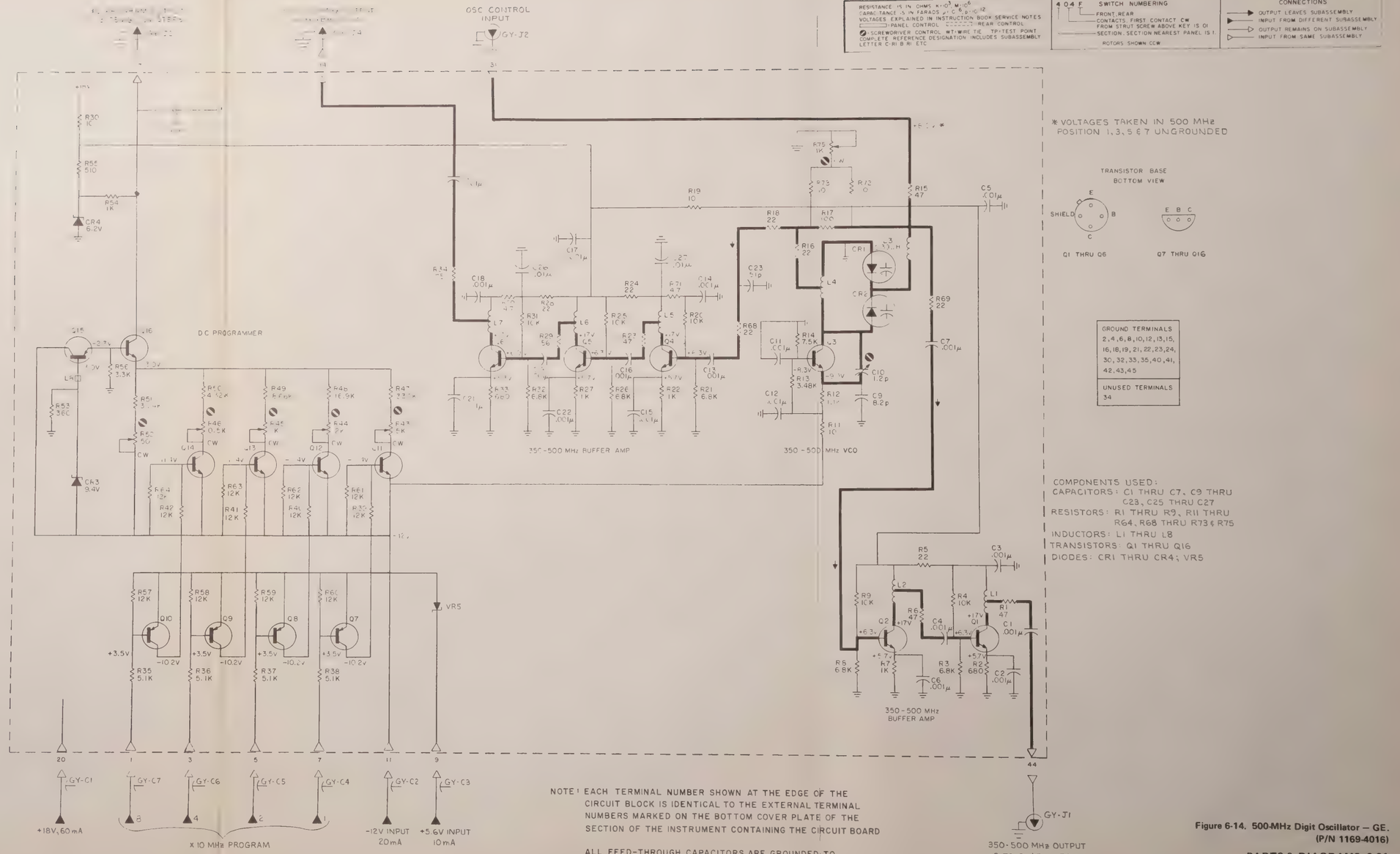
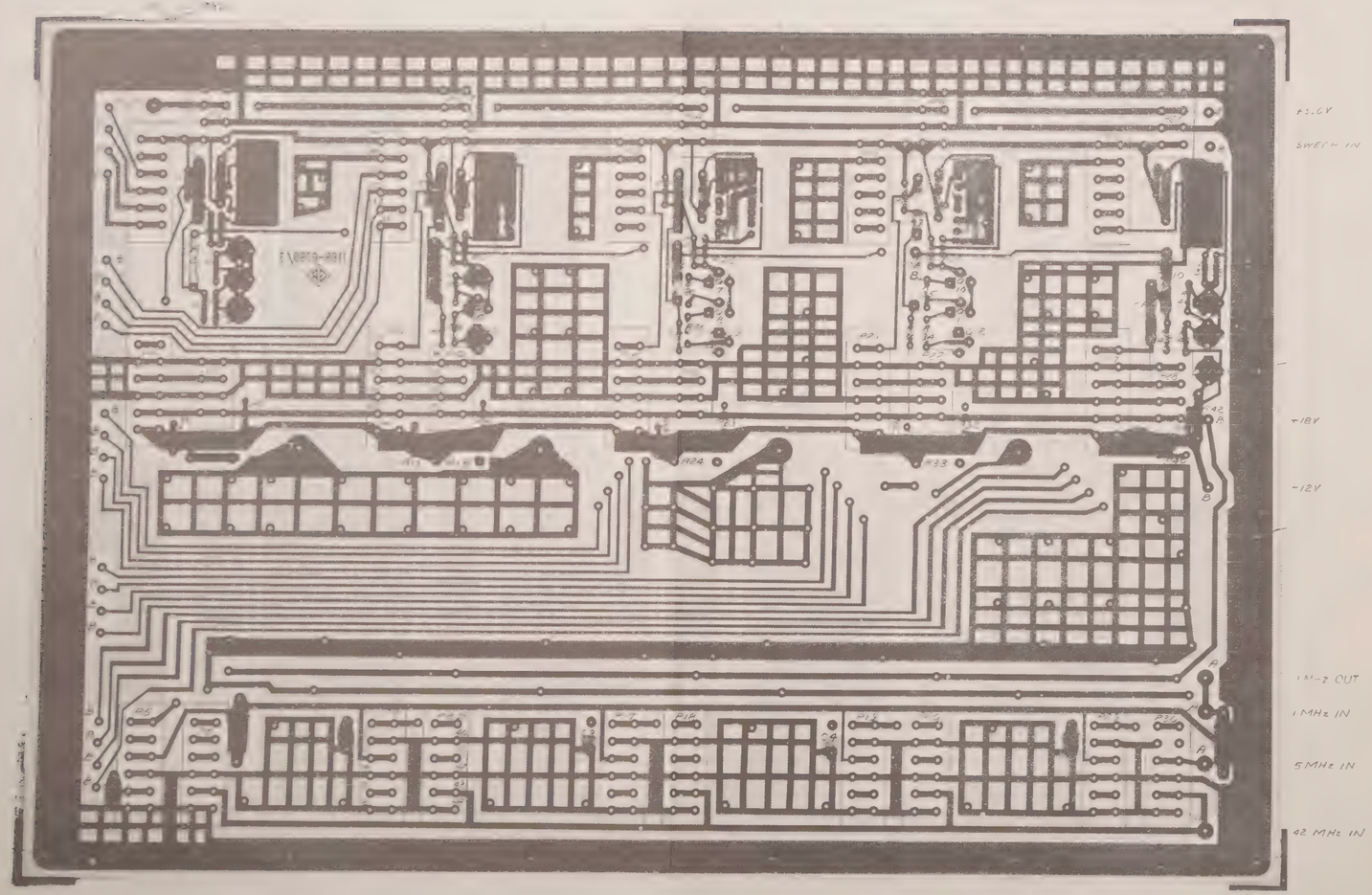

RESISTANCE IS IN OHMS K=10³ M=10⁶
CAPACITANCE IS IN FARADS μ=10⁻⁶ p=10⁻¹²
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
PANEL CONTROL
REAR CONTROL
SCREWDRIVER CONTROL WITH WIRE TIE
TP=TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER C IN R IN ETC
4 0 4 F SWITCH NUMBERING
FRONT REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION SECTION NEAREST PANEL IS 1
ROTORS SHOWN CCW
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY
OSC CONTROL INPUT
GY-J2
DC PROGRAMMER
350-500 MHz BUFFER AMP
350-500 MHz VCO
350-500 MHz BUFFER AMP
VR5
*VOLTAGES TAKEN IN 500 MHz POSITION 1, 3, 5 & 7 UNGROUNDED
TRANSISTOR BASE BOTTOM VIEW
SHIELD
E
B
C
E B C
Q1 THRU Q6
Q7 THRU Q16
GROUND TERMINALS
2,4,6,8,10,12,13,15,16,18,19,21,22,23,24,30,32,33,35,40,41,42,43,45
UNUSED TERMINALS
34
COMPONENTS USED:
CAPACITORS: C1 THRU C7, C9 THRU C23, C25 THRU C27
RESISTORS: R1 THRU R9, R11 THRU R64, R68 THRU R73 & R75
INDUCTORS: L1 THRU L8
TRANSISTORS: Q1 THRU Q16
DIODES: CR1 THRU CR4; VR5
GY-C1
GY-C7
GY-C6
GY-C5
GY-C4
GY-C2
GY-C3
+18V, 60mA
x 10 MHz PROGRAM
-12V INPUT 20mA
+5.6V INPUT 10mA
GY-J1
350-500 MHz OUTPUT -3 TO 0 dBm 50Ω
NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD
ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF

Figure 6-14. 500-MHz Digit Oscillator – GE. (P/N 1169-4016)



Etched-circuit diagram, Motherboard — H (P/N 1169-4090).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4090 MOTHER BOARD					
CAPACITORS					
C1 thru C5	Ceramic, 1000 pF ±10% 500 V	4405-2105	72982	801, 1000 pF ±10%	5910-914-0087
CHOKES					
L1 thru L5	Molded, 220 µH ±10%	4300-7556	99800	1025-14, 220 µH ±10%	
CONNECTORS					
P1	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P2	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P3	PC, 6 Pos, Dr.	5230-6221	00032	#4-583486-5	
P4	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P5 thru P9	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P10	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P11	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P12	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P13	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P14	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P15	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P16	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P17 thru P21	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P22	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P23	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P24	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P25	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P26	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P27	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P28	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P29 and P30	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
DIODES					
CR1 thru CR10	Type BA136A	6082-1035	25088	BA136A	
INTEGRATED CIRCUITS					
U1 thru U5	Digital, Type SN74L00N	5431-8300	96214	SN74L00N	
RESISTORS					
R1 and R2	Comp., 3.3 kΩ ±5% 1/8 W	6098-2335	01121	BB, 3.3 kΩ ±5%	5905-681-9969
R3	Comp., 2 kΩ ±5% 1/8 W	6098-2205	01121	BB, 2 kΩ ±5%	5905-686-3370
R4	Comp., 56 kΩ ±5% 1/8 W	6098-3565	01121	BB, 56 kΩ ±5%	5905-800-0179
R5	Comp., 5.6 kΩ ±5% 1/8 W	6098-2565	01121	BB, 5.6 kΩ ±5%	5905-681-0195
R6	Comp., 750 Ω ±5% 1/4 W	6099-1755	75042	BTS, 750 Ω ±5%	
R7	Comp., 2.2 kΩ ±5% 1/8 W	6098-2225	01121	BB, 2.2 kΩ ±5%	
R8	Comp., 27 kΩ ±5% 1/8 W	6098-3275	01121	BB, 27 kΩ ±5%	
R9	Comp., 56 kΩ ±5% 1/8 W	6098-3565	01121	BB, 56 kΩ ±5%	5905-800-0179
R10 and R11	Comp., 3.3 kΩ ±5% 1/8 W	6098-2335	01121	BB, 3.3 kΩ ±5%	5905-681-9969
R12	Comp., 2 kΩ ±5% 1/8 W	6098-2205	01121	BB, 2 kΩ ±5%	5905-686-3370
R13	Comp., 56 kΩ ±5% 1/8 W	6098-3565	01121	BB, 56 kΩ ±5%	5905-800-0179
R14	Comp., 5.6 kΩ ±5% 1/8 W	6098-2565	01121	BB, 5.6 kΩ ±5%	5905-691-0195
R15	Comp., 750 Ω ±5% 1/4 W	6099-1755	75042	BTS, 750 Ω ±5%	
R16	Comp., 2.2 kΩ ±5% 1/8 W	6098-2225	01121	BB, 2.2 kΩ ±5%	
R17	Comp., 27 kΩ ±5% 1/8 W	6098-3275	01121	BB, 27 kΩ ±5%	
R18	Comp., 56 kΩ ±5% 1/8 W	6098-3565	01121	BB, 56 kΩ ±5%	5905-800-0179
R19 and R20	Comp., 3.3 kΩ ±5% 1/8 W	6098-2335	01121	BB, 3.3 kΩ ±5%	5905-681-9969
R21	Comp., 2 kΩ ±5% 1/8 W	6098-2205	01121	BB, 2 kΩ ±5%	5905-686-3370
R22	Comp., 56 kΩ ±5% 1/8 W	6098-3565	01121	BB, 56 kΩ ±5%	5905-800-0179

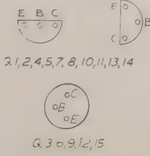
ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No	Fed Stock No
					5905-691-0195
					5905-800-0179
					5905-681-9969
					5905-686-3370
					5905-800-0179
					5905-691-0195
					5905-800-0179
					5905-681-9969
					5905-686-3370
					5905-681-9969
					5905-800-0179
					5905-691-0195
			01121	BB, 27 kΩ ±5%	
			01121	BB, 56 kΩ ±5%	5905-800-0179

TRANSISTORS

Q1 and Q2	Type 2N4125	8210-1125	04713	2N4125	
Q3	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755
Q4 and Q5	Type 2N4125	8210-1125	04713	2N4125	
Q6	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755
Q7 and Q8	Type 2N4125	8210-1125	04713	2N4125	
Q9	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755
Q10 and Q11	Type 2N4125	8210-1125	04713	2N4125	
Q12	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755
Q13 and Q14	Type 2N4125	8210-1125	04713	2N4125	
Q15	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755

TRANSISTOR BASING
(BOTTOM VIEW)
DEPENDING UPON SUPPLIER



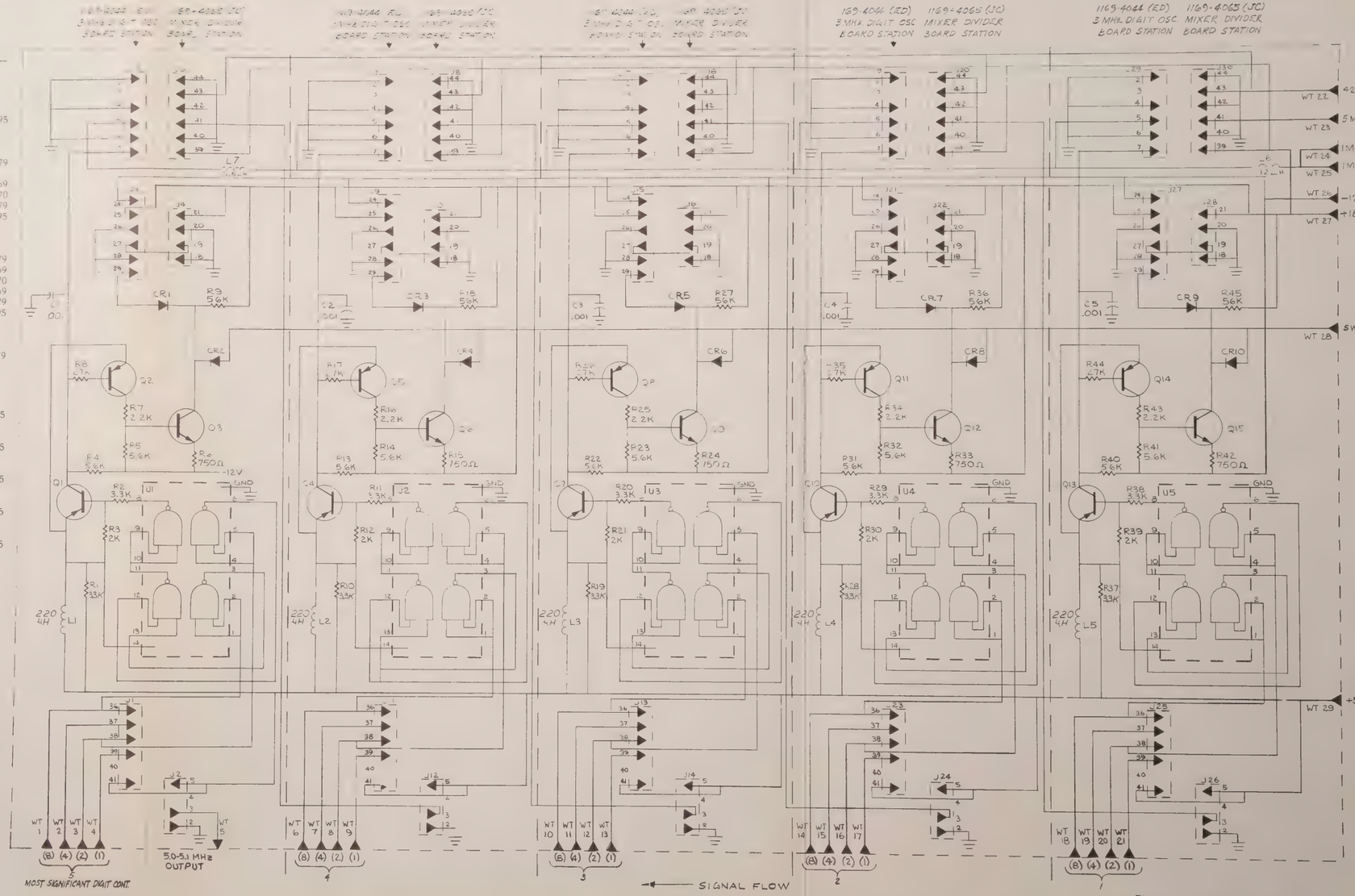
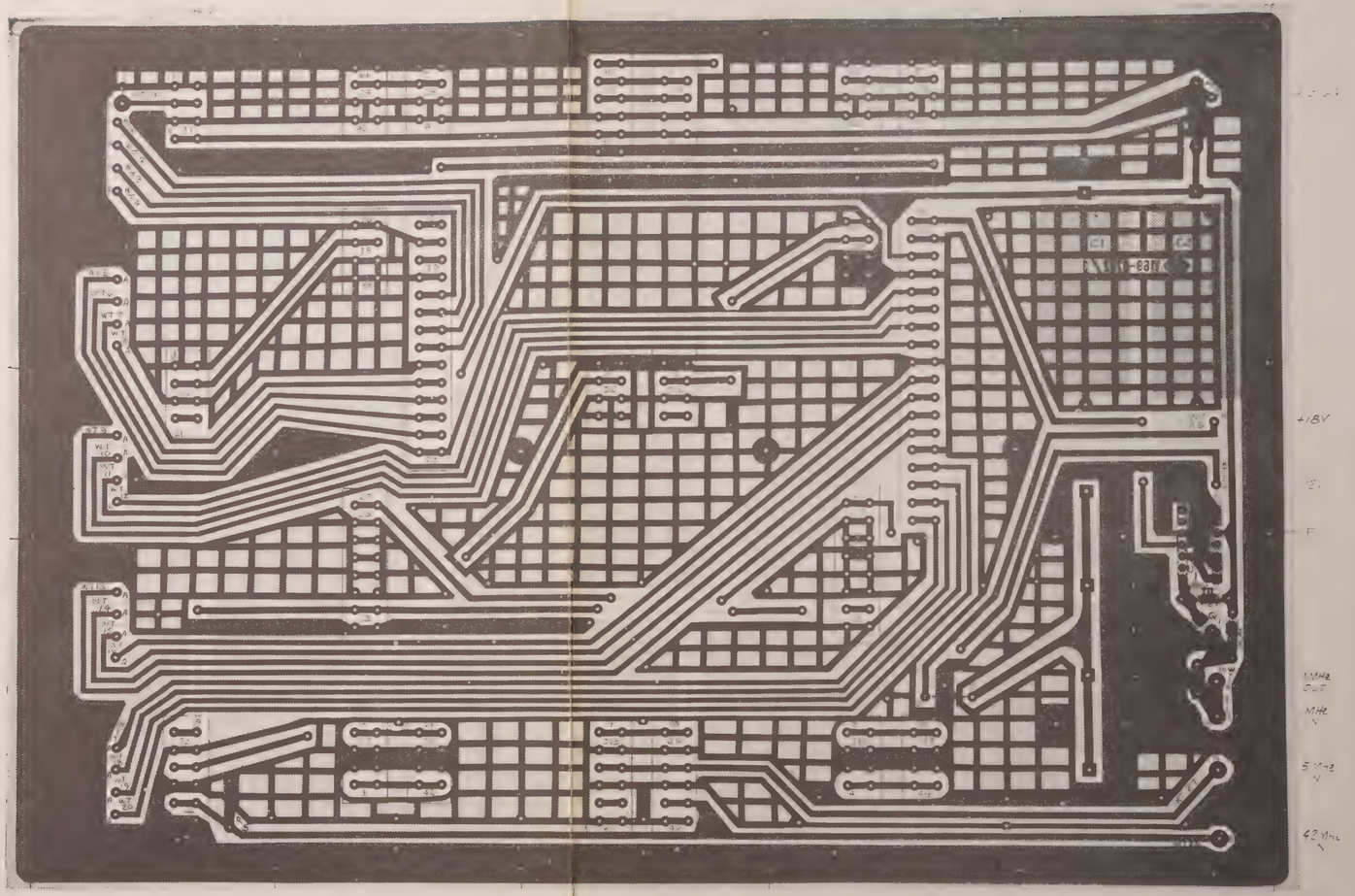

1169-4044 (ED) 3 MHz DIGIT OSC BOARD STATION
1169-4065 (JC) MIXER DIVIDER BOARD STATION
WT 22 42 MHz I
WT 23 5 MHz INP
WT 24 1 MHz OUT
WT 25 1 MHz INPUT
WT 26 -12V
WT 27 +18V
WT 28 SWEEP INPUT
WT 29 +5.6
CR1 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9 CR10
R9 5.6K R27 56K R36 56K R45 56K
R8 4.7K R17 4.7K R26 4.7K R35 4.7K R44 4.7K
R7 2.2K R16 2.2K R25 2.2K R34 2.2K R43 2.2K
R6 5.6K R14 5.6K R23 5.6K R32 5.6K R41 5.6K
R5 750Ω R15 750Ω R24 150Ω R33 750Ω R42 750Ω
R4 5.6K R13 5.6K R22 5.6K R31 5.6K R40 5.6K
-12V
GND
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15
R2 3.3K R11 3.3K R20 3.3K R29 3.3K R38 3.3K
R3 2K R12 2K R21 2K R30 2K R39 2K
R1 33K R10 33K R19 33K R28 33K R37 33K
220 4H L1 L2 L3 L4 L5
U1 U2 U3 U4 U5
J1 J2 J11 J12 J13 J14 J23 J24 J25 J26
WT 1 WT 2 WT 3 WT 4
WT 5
50-51 MHz OUTPUT
WT 6 WT 7 WT 8 WT 9
WT 10 WT 11 WT 12 WT 13
WT 14 WT 15 WT 16 WT 17
WT 18 WT 19 WT 20 WT 21
(8) (4) (2) (1)
5
4
3
2
MOST SIGNIFICANT DIGIT CONT.
SIGNAL FLOW

Figure 6-15. Motherboard (Fine Resolution – Standard) H (P/N 1169-4090)

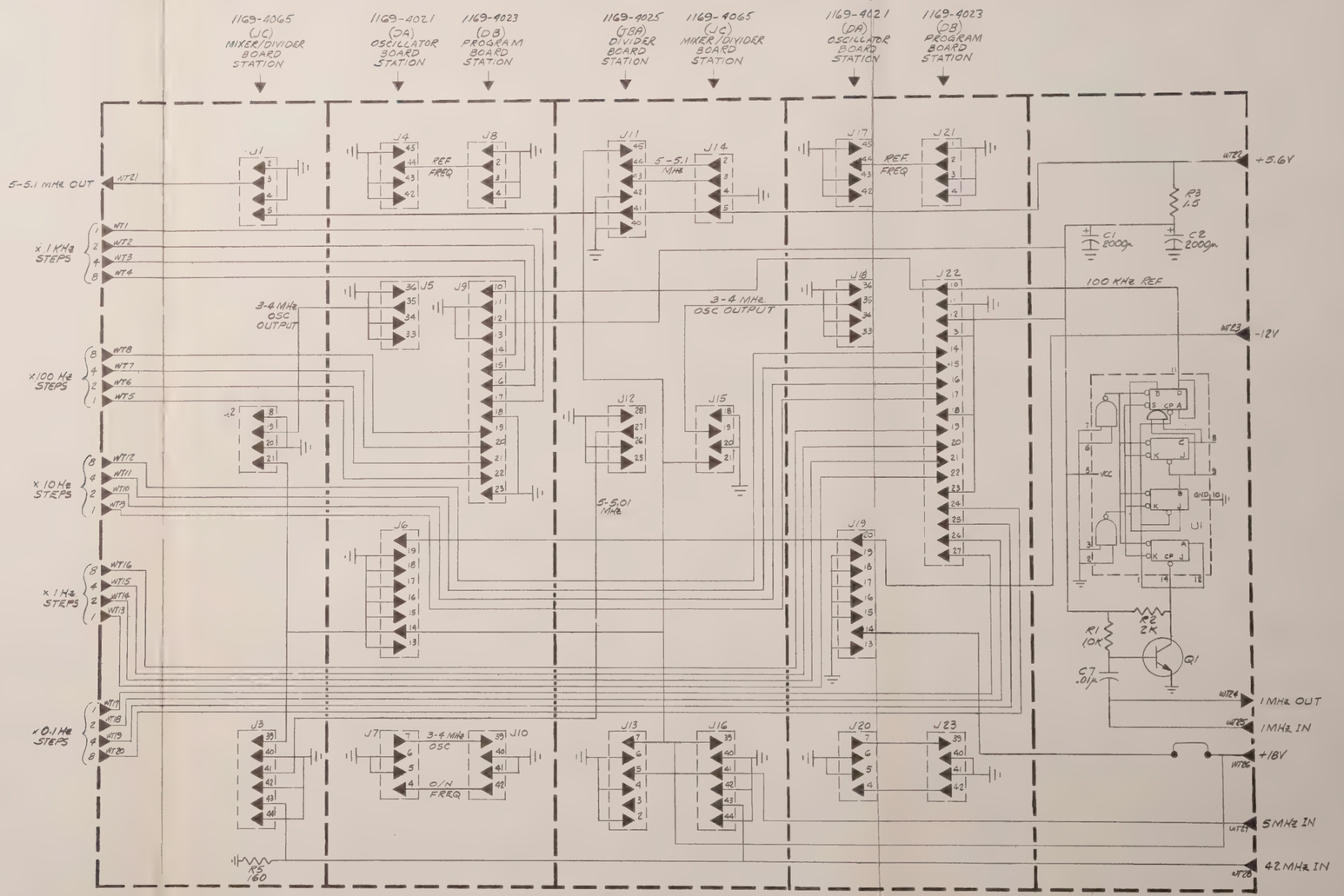
TRANSISTORS

Q1	Type 2N4123		1471	2N4123

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



Etched-circuit diagram, Motherboard – H (P/N 1169-4092).



RESISTANCE IS IN OHMS K = 10^3 M = 10^6
CAPACITANCE IS IN FARADS μ = 10^{-6} p = 10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
PANEL CONTROL ( ) REAR CONTROL
SCREWDRIVER CONTROL WT - WIRE TIE TP - TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER (A1, B1, etc.)

4 0 4 F ROTARY SWITCH NUMBERING
WAFER SURFACE FRONT REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 91
SECTION SECTION NEAREST PANEL IS 1
ROTORS SHOWN FCW

CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

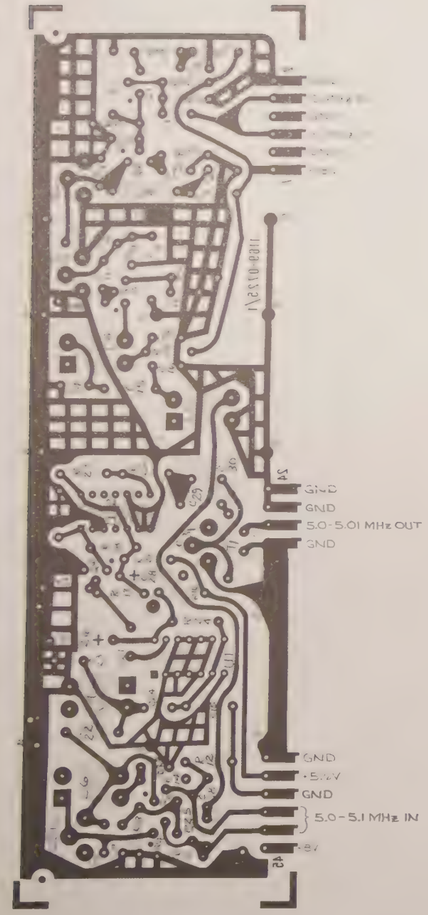
Figure 6-16. Motherboard (Fine Resolution-Economy H (P/N 1169-4092)

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4025 DIVIDER BOARD ASM (JBA)					
CAPACITORS					
C1 and C2	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C3	Mica, 121 pF ±1% 500 V	4710-0031	14655	22A, 121 pF ±1%	
C4 and C5	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C6	Trimmer Ceramic, 5.5-18 pF	4910-2031	72982	538-006, 5.5 to 18 pF NPO	
C7	Ceramic, 56 pF ±5% 100 V N080	4412-0565	72982	831, 56 pF ±5%	
C8	Ceramic Tubular, 2.7 pF ±10% 500 V	4400-0279	78488	GA, 2.7 pF ±10%	
C9	Ceramic, 56 pF ±5% 100 V N080	4412-0565	72982	831, 56 pF ±5%	
C10	Trimmer Ceramic, 5.5-18 pF	4910-2031	72982	538-006, 5.5 to 18 pF NPO	
C11	Ceramic, 6.2 pF ±5% 500 V N030	4411-9625	72982	831, 6.2 pF ±5%	
C12 and C13	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C14	Ceramic, 75 pF ±5% 100 V N150	4413-1002	72982	855, 75 pF ±5%	
C15	Ceramic Tubular, 1 pF ±10% 500 V	4400-0100	78488	GA, 1 pF ±10%	5910-034-5367
C16	Ceramic, 75 pF ±5% 100 V N150	4413-1002	72982	855, 75 pF ±5%	
C17 and C18	Ceramic, 47 pF ±5% 500 V	4404-0475	72982	831, 47 pF ±5%	
C19	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C20	Ceramic, 27 pF ±5% 100 V N030	4411-2007	72982	835, 27 pF ±5%	
C21	Trimmer Ceramic, 5.5-18 pF	4910-2031	72982	538-006, 5.5 yo 18 pF NPO	
C22	Ceramic Tubular, 1 pF ±10% 500 V	4400-0100	78488	GA, 1 pF ±10%	5910-034-5367
C23	Ceramic, 62 pF ±5% 100 V N150	4413-1001	72982	855, 62 pF ±5%	
C24	Ceramic, 6.8 pF ±5% 500 V N030	4411-9685	09392	831, 6.8 pF ±5%	
C25	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C26	Tantalum, 3.3 µF ±20% 15 V	4450-4600	56289	150D335X0015A2	5910-837-9325
C27	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C28	Tantalum, 3.3 µF ±20% 15 V	4450-4600	56289	150D335X0015A2	5910-837-9325
C29	Mica, 1200 pF ±5% 500 V	4700-0685	14655	22A, 1200 pF ±5%	
C30	Mica, 162 pF ±1% 500 V	4710-0162	14655	22A, 162 pF ±1%	
C31	Trimmer Ceramic, 5.5-18 pF	4910-2031	72982	538-006, 5.5 to 18 pF NPO	
CHOKES					
L1	9.1 µH ±2%	4300-7532	99800	1537-44	
L2 and L3	Molded, 1.5 µH ±10%	4300-1000	99800	1537, 1.5 µH ±10%	
1169-4025 DIVIDER BOARD ASM (JBA)					
INDUCTOR ASM					
L4 and L5	(RD)	1165-2410	24655	1165-2410	
L6	(BK)	1165-2470	24655	1165-2470	
L7	(VT)	1165-2415	24655	1165-2415	
INTEGRATED CIRCUITS					
U1	Digital, Type MC10132	5431-9610	04713	MC10131	
U2	Digital, Type 5431-8190	18080		5431-8190	
RESISTORS					
R1	Comp., 18 kΩ ±5% 1/4 W	6099-3185	75042	BTS, 18 kΩ ±5%	5905-687-0000
R2	Comp., 1.5 kΩ ±5% 1/4 W	6099-2155	75042	BTS, 1.5 kΩ ±5%	
R3	Comp., 360 Ω ±5% 1/4 W	6099-1365	75042	BTS, 360 Ω ±5%	
R4	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R5	Comp., 2.2 kΩ ±5% 1/4 W	6099-2225	75042	BTS, 2.2 kΩ ±5%	5905-723-5251
R6	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R7	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R8	Comp., 910 Ω ±5% 1/4 W	6099-1915	75042	BTS, 910 Ω ±5%	
R9	Comp., 240 Ω ±5% 1/4 W	6099-1245	75042	BTS, 240 Ω ±5%	
R10	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R11 and R12	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R13	Comp., 240 Ω ±5% 1/4 W	6099-1245	75042	BTS, 240 Ω ±5%	
R14	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R15	Comp., 2.7 kΩ ±5% 1/4 W	6099-2275	75042	BTS, 2.7 kΩ ±5%	
R16	Comp., 18 Ω ±5% 1/4 W	6099-0185	75042	BTS, 18 Ω ±5%	
R17	Comp., 1.8 kΩ ±5% 1/4 W	6099-2185	75042	BTS, 1.8 kΩ ±5%	5905-688-3738
R18	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
R19	Comp., 390 Ω ±5% 1/4 W	6099-1395	75042	BTS, 390 Ω ±5%	
R21	Comp., 15 Ω ±5% 1/4 W	6099-0155	75042	BTS, 15 Ω ±5%	
R22	Comp., 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R23	Comp., 2.2 kΩ ±5% 1/4 W	6099-2225	75042	BTS, 2.2 kΩ ±5%	5905-723-5251
R24	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
R25	Comp., 1.5 kΩ ±5% 1/4 W	6099-2155	75042	BTS, 1.5 kΩ ±5%	
TRANSFORMERS					
T1		1160-2611	24655	1160-2611	
TRANSISTORS					
Q1	Type 2N3905	8210-1114	04713	2N3905	
Q2 thru Q5	Type 2N3903	8210-1132	04713	2N3903	
Q6	Type 2N4275	8210-1126	07263	2N4275	



Etched-circuit diagram, Divider board – JBA (P/N 1169-4025).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

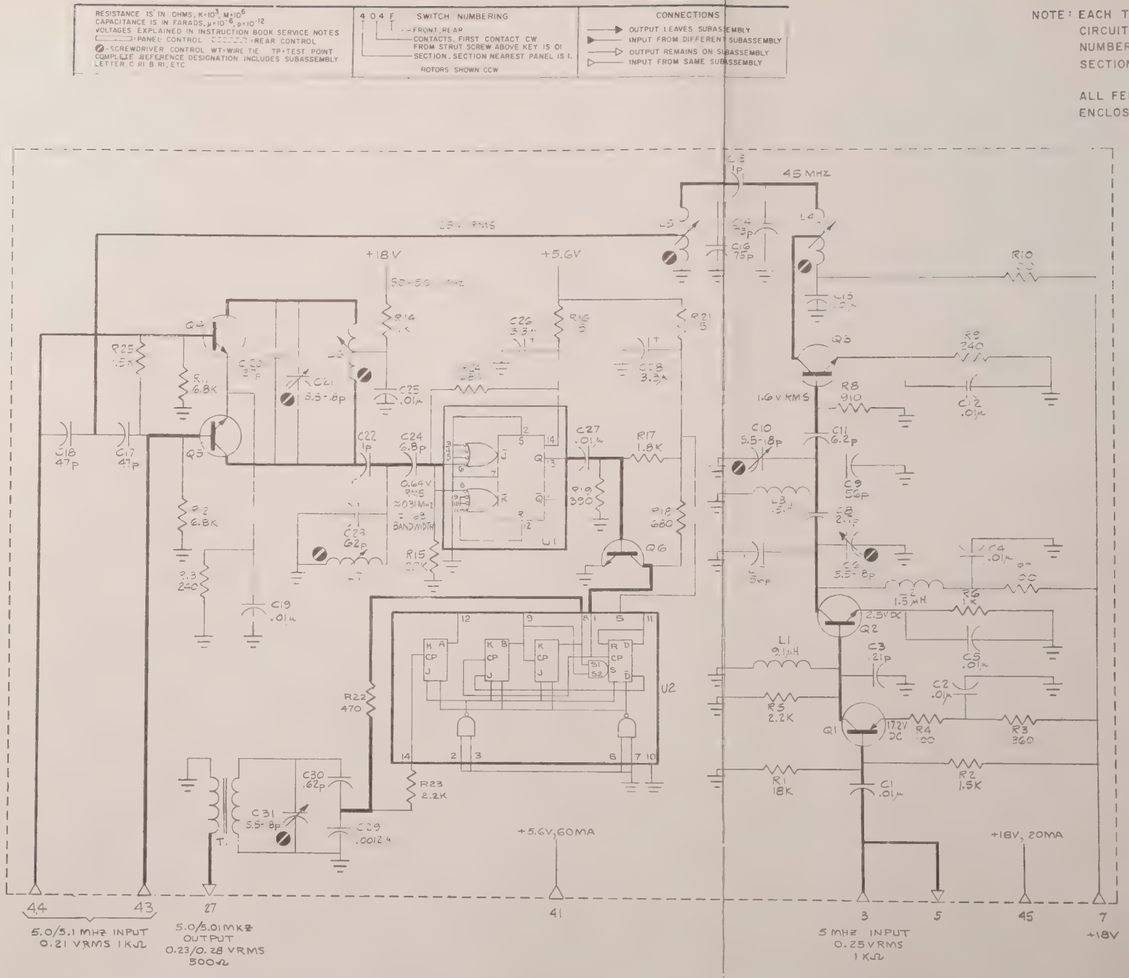
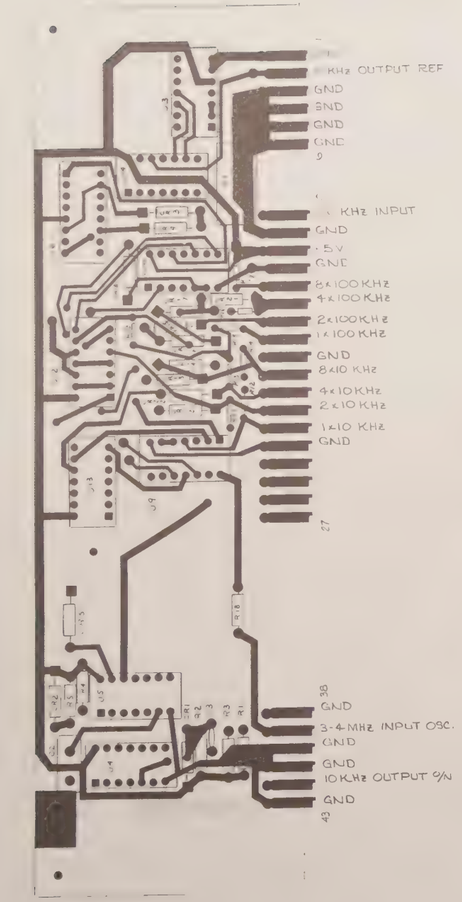

RESISTANCE IS IN OHMS, K=10³, M=10⁶
CAPACITANCE IS IN FARADS, μ=10⁻⁶, p=10⁻¹²
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
PANEL CONTROL
REAR CONTROL
SCREWDRIVER CONTROL WT=WIRE TIE TP=TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C R1, B R1, ETC
4 0 4 F
SWITCH NUMBERING
FRONT, REAR
CONTACTS, FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY
NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD
ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE .1000 pF
(JB TERMINALS)
TRANSISTOR BASING (BOTTOM VIEW)
E B C
Q1, 2, 3, 4, 5
B
E C
Q6
+18V
+5.6V
45 MHz
1.6 V RMS
2.5 VDC
1.72 V DC
+5.6V, 60MA
+18V, 20MA
5.0/5.1 MHz INPUT 0.21 VRMS 1 KΩ
5.0/5.01 MHz OUTPUT 0.23/0.28 VRMS 500Ω
5 MHz INPUT 0.25 VRMS 1 KΩ
44
43
27
41
3
5
45
7
+18V

Figure 6-17. 5.01-MHz Inter. Mixer Divider JBA. (P/N 1169-4025)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4023 PROGRAM BOARD (DB)					
CAPACITORS					
C1	Tantalum, 330 µF ±20% 6V	4450-5707	37942	TT, 330 µF ±20%	
C2	Mica, 464 pF ±20% 500 V	4710-0535	14655	22A, 464 pF ±20%	5910-052-6547
C3	Ceramic, 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
DIODES					
CR1 thru CR5	Type 1N995	6082-1002	80368	1N995	5961-893-6762
CR12 thru CR18	Type 1N995	6082-1002	80368	1N995	5961-893-6762
CR21 and CR22	Type 1N995	6082-1002	80368	1N995	5961-893-6762
INTEGRATED CIRCUITS					
IC9 and IC10	Type N8280A	5431-9604	18324	N8280A	
U3	Type SN7490N	5431-8190	96214	SN7490N	
U4 and U5	Type SN7400N	5431-8100	96214	SN7400N	
U6	Type SN7476N	5431-8176	96214	SN7476N	
U12	Type SN15836N	5431-9362	96214	SN15836N	
U13	Type SN15846N	5431-9462	96214	SN15846N	
U14	Type SN74H10N	5431-8210	96214	SN74H10N	
RESISTORS					
R1	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R2	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
R3 and R4	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R5	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
R12 thru R17	Comp., 3.3 kΩ ±5% 1/8 W	6098-2335	01121	BB, 3.3 kΩ ±5%	
R18	Comp., 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R19 and R20	Comp., 10 kΩ ±5% 1/8 W	6098-3105	01121	BB, 10 kΩ ±5%	

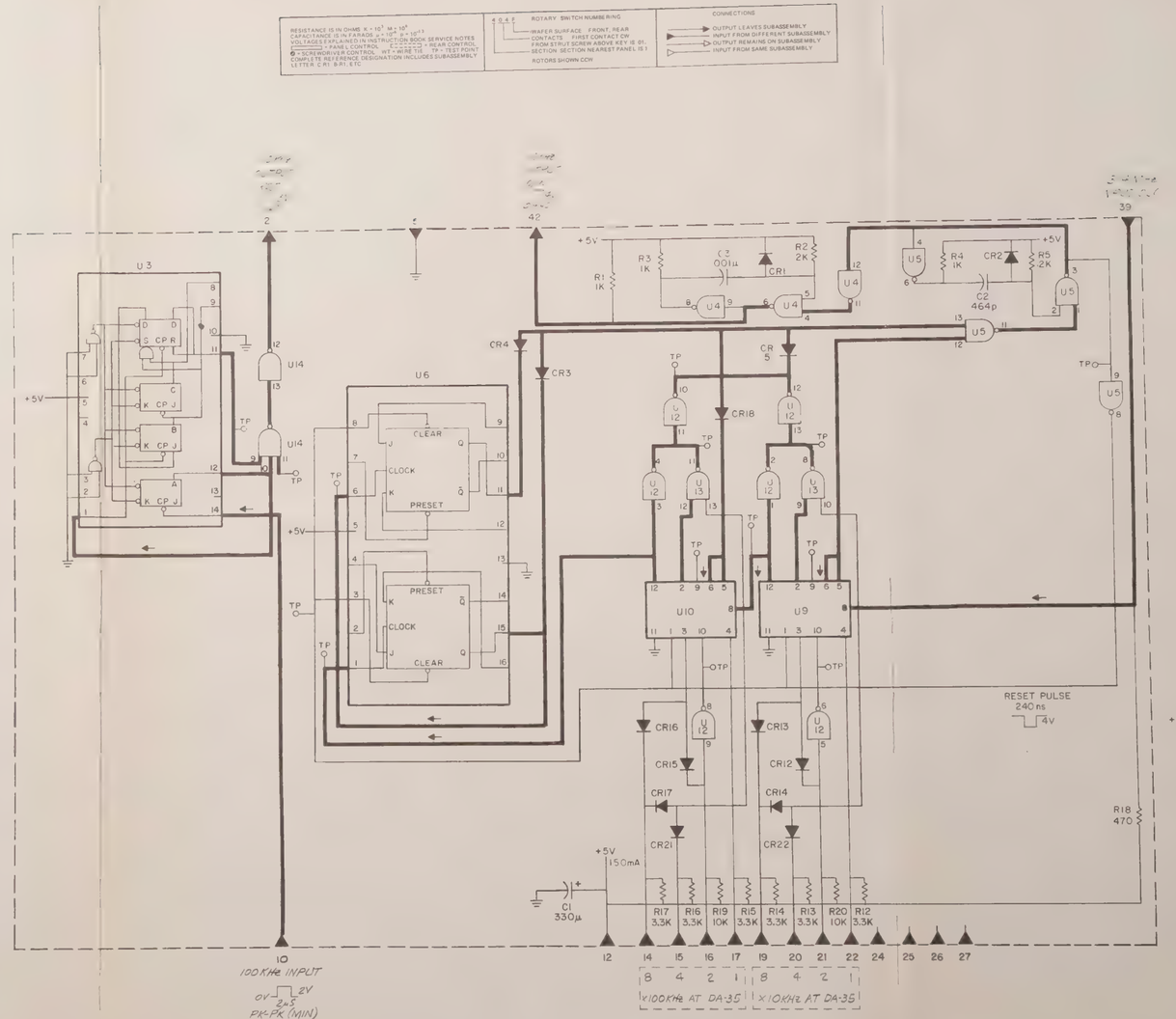


Etched-circuit diagram, Program circuit board – DB (P/N 1169-4023).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF



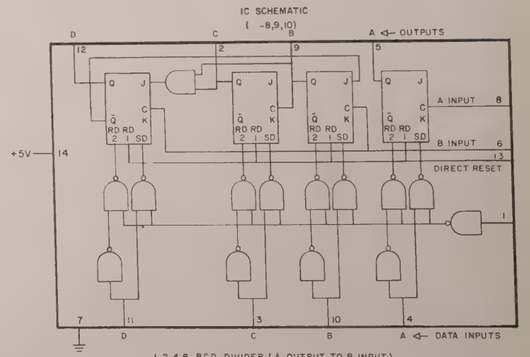


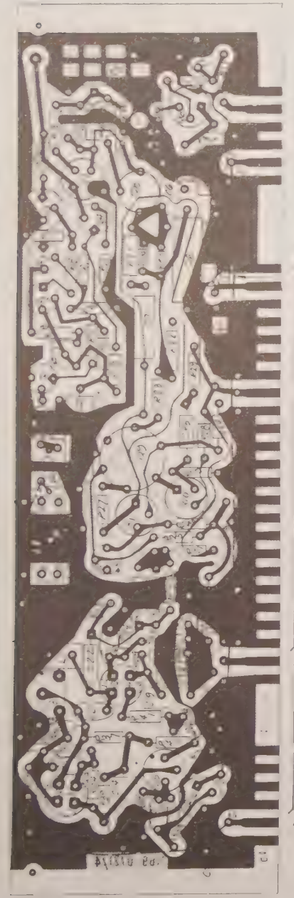
Figure 6-18. Part 1. Two-decade digit osc. prog. – DB (P/N 1169-4023).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4021 OSCILLATOR CIRCUIT ASM (DA)					
CAPACITORS					
C2	Elect., 150 µF ±20% 20 V	4450-5723	90201	20000331100107	
C3	Elect., 15 µF ±20% 20 V	4450-5200	56289	150D156X0020B2	5910-855-6335
C4	Ceramic, 24 pF ±5% 500 V	4410-0245	72982	811, 24 pF ±5%	
C5	Mylar, .1 µF ±5% 100 V	4860-8254	84411	663UW, .1 µF ±5%	
C6	Mylar, .01 µF ±5% 100 V	4860-7755	84411	663UW, .01 µF ±5%	
C7	Mylar, .01 µF ±1% 100 V	4860-7752	84411	663UW, .01 µF ±1%	
C8	Mylar, .00280 µF ±1% 200 V	4860-7346	84411	663UW, 00280 µF ±1%	
C9	Tant., 15 µF ±20% 20 V	4450-5200	56289	150D156X0020B2	5910-855-6335
C10	Ceramic, 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
C11	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C12	Mica, 330 µF ±5% 500 V	4700-0516	14655	22A, 33 µF ±5%	
C13	Trimmer Cer., 5.5-18 pF	4910-2031	72982	538-006, 5.5-18 pF	
C14 and C15	Tant., 15 µF ±20% 20 V	4450-5200	56289	150D156X0020B2	5910-855-6335
C16	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C17	Mylar, .022 µF ±10% 100 V	4860-7860	84411	663UW, .022 µF ±10%	5910-055-6119
C18	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C19	Mica, 169 µF ±2% 500 V	4700-0443	14655	22A, 169 µF ±2%	
C20 and C21	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
CHOKES					
L1	Variable 17-18 µH	4300-3700	72982	538-006, 5.5-18 pF	
L2	Molded 18 µH ±10%	4300-2500	99800	1537-42	
COILS					
L3	Wound	1452-1510	24655	1452-1510	
DIODES					
CR1 and CR2	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
CR3 and CR4	Type 1N4442	6082-1009	24446	1N4442	5961-929-9967
CR5 and CR6	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
CR7 and CR8	Type 1N4442	6082-1009	24446	1N4442	5961-929-9967
RESISTORS					
R1 and R2	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R3	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R4	Comp., 3.9 kΩ ±5% 1/4 W	6099-2395	75042	BTS, 3.9 kΩ ±5%	
R5	Comp., 3.3 kΩ ±5% 1/4 W	6099-2335	75042	BTS, 3.3 kΩ ±5%	5905-681-9969
R6	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R7	Comp., 300 Ω ±5% 1/4 W	6099-1305	75042	BTS, 300 Ω ±5%	5905-279-5481
R8	Comp., 330 Ω ±5% 1/4 W	6099-1335	75042	BTS, 330 Ω ±5%	5905-686-3369
R10	Comp., 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R11	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	5905-683-2243
R12	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R13	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	5905-683-2243
R14	Comp., 2.2 kΩ ±5% 1/4 W	6099-2225	75042	BTS, 2.2 kΩ ±5%	5905-723-5251
R15	Comp., 750 Ω ±5% 1/4 W	6099-1755	75042	BTS, 750 Ω ±5%	
R16	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R17	Pot Cermet, 200 Ω ±10% 1/2 W	6049-0293	24655	6049-0293	
R18	Comp., 200 Ω ±10% 1/4 W	6099-1205	75042	BTS, 200 Ω ±10%	5905-683-2239
R19	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
R20	Comp., 7.5 kΩ ±5% 1/4 W	6099-2755	75042	BTS, 7.5 kΩ ±5%	
R21 and R22	Film, 11.8 kΩ ±1% 1/8 W	6250-2118	75042	CEA, 11.8 kΩ ±1%	
R23	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	5905-683-2243
R24 and R25	Comp., 15 kΩ ±5% 1/4 W	6099-3155	75042	BTS, 15 kΩ ±5%	5905-681-8818
R26	Comp., 390 Ω ±5% 1/4 W	6099-1395	75042	BTS, 390 Ω ±5%	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R27	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	5905-683-2243
R28 and R29	Comp., 11 kΩ ±5% 1/4 W	6099-3115	75042	BTS, 11 kΩ ±5%	
R30	Comp., 12 kΩ ±5% 1/4 W	6099-3125	75042	BTS, 12 kΩ ±5%	
R31	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R32	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R33	Comp., 100 kΩ ±5% 1/4 W	6099-4105	75042	BTS, 100 kΩ ±5%	5905-686-3129
R34	Comp., 39 kΩ ±5% 1/4 W	6099-3395	75042	BTS, 39 kΩ ±5%	5905-686-3358
R35	Comp., 15 kΩ ±5% 1/4 W	6099-3155	75042	BTS, 15 kΩ ±5%	5905-681-8818
R36	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R37	Comp., 3.9 MΩ ±5% 1/4 W	6099-5395	75042	BTS, 3.9 MΩ ±5%	
R38	Comp., 2 MΩ ±5% 1/4 W	6099-5205	75042	BTS, 2 MΩ ±5%	
R39	Comp., 560 Ω ±5% 1/4 W	6099-1565	75042	BTS, 560 Ω ±5%	
R40	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R41	Comp., 150 Ω ±5% 1/4 W	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
R42	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R43	Comp., 110 kΩ ±5% 1/4 W	6099-4115	75042	BTS, 110 kΩ ±5%	
R44	Comp., 20 kΩ ±5% 1/4 W	6099-3205	75042	BTS, 20 kΩ ±5%	5905-686-3368
R45	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R46	Comp., 3.3 kΩ ±5% 1/4 W	6099-2335	75042	BTS, 3.3 kΩ ±5%	5905-681-9969
TRANSFORMERS					
T1	Asm	5000-2121	24655	5000-2121	
T2		1165-2300	24655	1165-2300	
TRANSISTORS					
Q1	Type 2N4123	8210-1123	04713	2N4123	
Q2	Type 2N3905	8210-1114	04713	2N3905	
Q3	Type 2N2218	8210-1028	96214	2N2218	5960-059-4464
Q4	Type 2N3903	8210-1132	04713	2N3903	
Q5	Type 2N3905	8210-1114	04713	2N3905	
Q6 thru Q8	Type 2N2218	8210-1028	96214	2N2218	5960-059-4464
Q9	Type DN-259	8210-1170	17856	DN-259	
Q10	Type 2N3903	8210-1132	04713	2N3903	
Q11 and Q12	Type 2N3905	8210-1114	04713	2N3905	
Q13 and Q14	Type 3N159	8210-1193	79089	3N159	
Q15	Type 2N3903	8210-1132	04713	2N3903	
Q16	Type 2N4123	8210-1123	04713	2N4123	



Etched-circuit diagram, Oscillator circuit board – DA (P/N 1168-4021).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

SWITCH NUMBERING
FRONT REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD

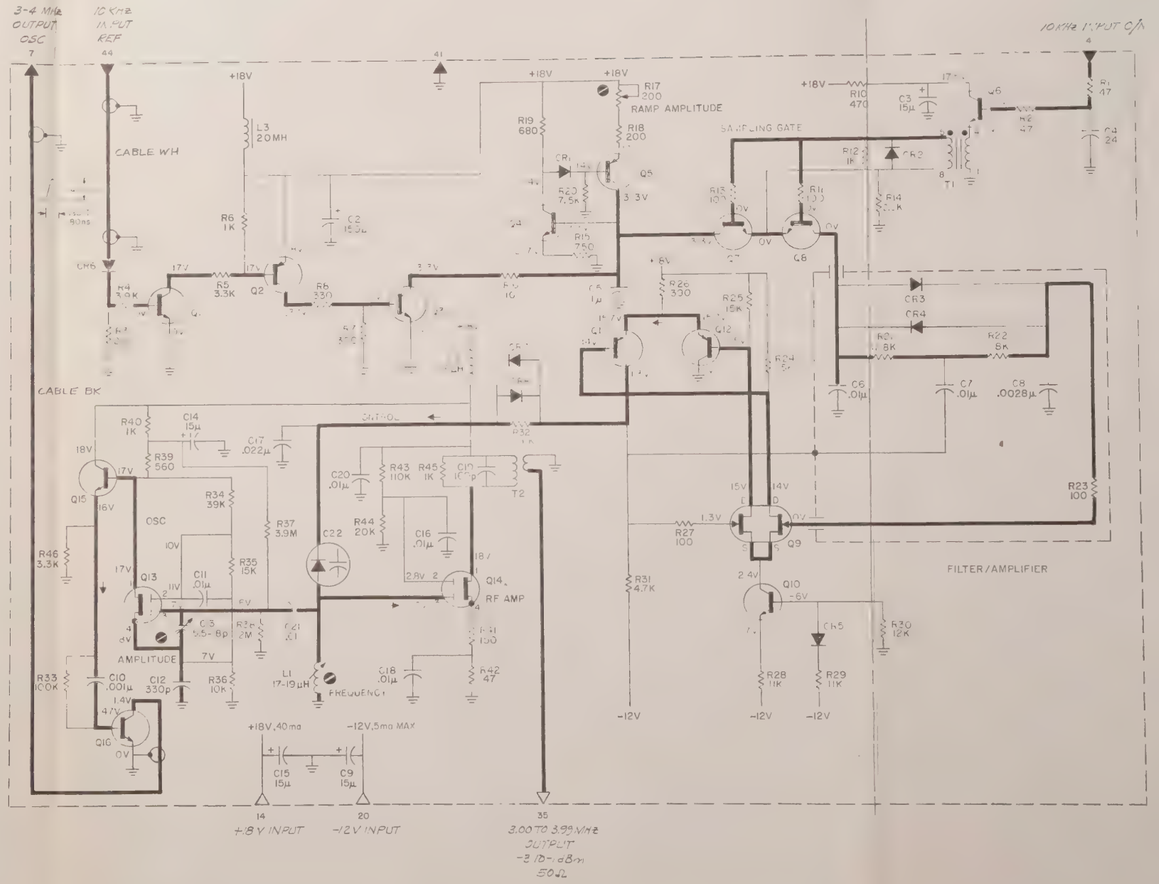


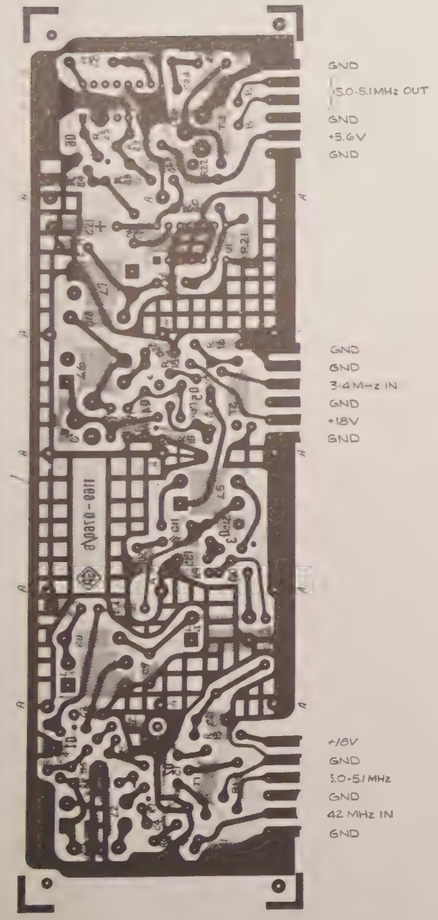
Figure 6-18. Part 2. Two-decade Digit Oscillator – DA. (P/N 1169-4021)

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4060 MIX/DIV CIRCUIT ASM (JA)					
CAPACITORS					
C1	169 pF ±2%	4700-0443	14655	22A, 169 pF ±2%	
C2	.01 µF +80-20%	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C3	Ceramic, 91 pF ±5% 100 V N030	4411-2000	72982	815-003-B1G0910J	
C4	.001 µF ±10%	4405-2108	72982	801, .001 µF ±10%	5910-914-0087
C5	.0042 µF ±20%	4405-2470	72982	801, .0047 µF ±20%	
C6	.01 µF +80-20%	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C7	Ceramic, 68 pF ±5% 100 V N150	4413-1000	72982	0855037P2C-00680J	
C8	.22 pF ±5%	4400-0022	78488	GA, .22 pF ±5%	
C9	Ceramic, 68 pF ±5% 100 V N150	4413-1000	72982	0855037P2C-00680J	
C10	Ceramic, 2.2 pF ±10% 500 V N030	4411-9225	72982	811, 2.2 pF ±10%	
C11	Ceramic, 68 pF ±5% 100 V N150	4413-1000	72982	0855037P2C-00680J	
C12	.01 µF +80-20%	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C13 and C14	330 pF ±5%	4404-1335	72982	831, 330 pF ±5%	
C15	Ceramic, 27 pF ±5% 100 V N030	4411-2007	72982	835, 27 pF ±5%	
C16	5.5-18 pF	4910-2031	72982	538-006, 5.5-18 pF	
C17	.01 µF +80-20%	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C18	2.7 pF ±10%	4400-0279	78488	GA, 2.7 pF ±10%	
C19	Ceramic, 56 pF, ±5%, 100 V, N030	4412-0565	09392	56 pF, ±5%	
C20	Ceramic, 6.8 pF 500 V N030	4411-9685	09392	831, 6.8 pF ±5%	
C21	Tantalum, 3.3 µF ±20% 5 V	4450-4600	56289	150D335X0015A	5910-837-9325
C22	.01 µF +80-20%	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C23	Tantalum, 3.3 µF ±20% 5 V	4450-4600	56289	150D335X0015A	5910-837-9325
C24	261 pF, ±5%				
C25	270 pF, ±1%				
C26	5.5-18 pF	4910-2031	72982	538-006, 5.5-18 pF	
C27 and C28	.01 µF +80-20%	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
CHOKES					
L1	Molded, 12 µH	4300-7525	98803	1025	
INTEGRATED CIRCUITS					
U1	Digital, Type MC1013L	5431-9610	04713	MC1013L	
U2	Digital, Type 5431-8190	5431-9609	18080	5431-8190	
INDUCTORS					
L2	Asm (BU)	1165-2405	24655	1165-2405	
L5	Asm (YE-RD)	1165-2411	24655	1165-2411	
RESISTORS					
R1	Comp., 220 Ω ±5%	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R2	Comp., 47 Ω ±5%	6099-0475	75042	BTS, 47 Ω ±5%	
R3	Comp., 1.2 kΩ ±5%	6099-2125	75042	BTS, 1.2 kΩ ±5%	
R4	Comp., 620 Ω ±5%	6099-1625	75042	BTS, 620 Ω ±5%	5905-801-6998
R5	Comp., 150 Ω ±5%	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
R6	Comp., 18 kΩ ±5%	6099-3185	75042	BTS, 18 kΩ ±5%	5905-687-0000
R7	Comp., 3.3 kΩ ±5%	6099-2335	75042	BTS, 3.3 kΩ ±5%	5905-681-9969
R8	Comp., 470 Ω ±5%	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R9	Comp., 1.8 kΩ ±5%	6099-2185	75042	BTS, 1.8 kΩ ±5%	5905-688-3738
R10	Comp., 22 kΩ, ±5%	6099-3225	75042	BTS, 22 kΩ, ±5%	
R11	Comp., 150 Ω ±5%	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
R12	Pot. Cermet, 200 Ω ±10%	6049-0293	01121	ZH2011	
R13	Comp., 51 Ω ±5%	6099-0515	75042	BTS, 51 Ω ±5%	
R14	Comp., 470 Ω ±5%	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R15 and R16	Comp., 6.8 kΩ ±5%	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R17	Comp., 1.5 kΩ ±5%	6099-2155	75042	BTS, 1.5 kΩ ±5%	
R18	Comp., 1.0 kΩ ±5%	6099-2105	75042	BTS, 1.0 kΩ ±5%	5905-681-6422
R19	Comp., 470 Ω ±5%	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R20	Comp., 680 Ω ±5%	6099-1685	75042	BTS, 680 Ω ±5%	
R21	Comp., 2.7 kΩ ±5%	6099-2275	75042	BTS, 2.7 kΩ ±5%	
R22	Comp., 18 Ω ±5%	6099-0185	75042	BTS, 18 Ω ±5%	
R23	Comp., 1.8 kΩ ±5%	6099-2185	75042	BTS, 1.8 kΩ ±5%	5905-688-3738

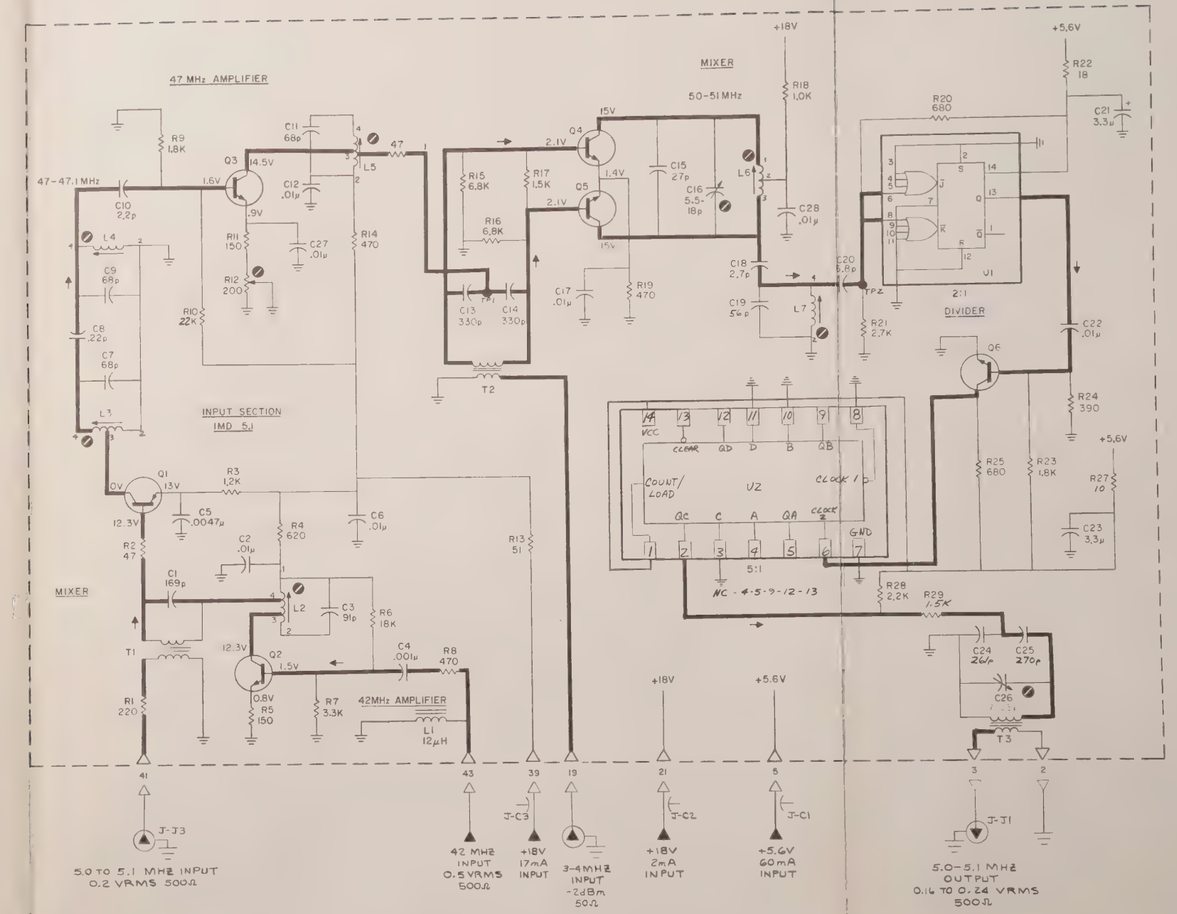
ELECTRICAL PARTS LIST (cont)

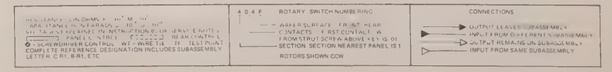
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
R24	Comp., 390 Ω ±5%	6099-1395	75042	BTS, 390 Ω ±5%	
R25	Comp., 680 Ω ±5%	6099-1685	75042	BTS, 680 Ω ±5%	
R27	Comp., 10 Ω, ±5%		75042	BTS, 10 Ω, ±5%	
R28	Comp., 2.2 kΩ ±5%	6099-2225	75042	BTS, 2.2 kΩ ±5%	5905-723-5251
R29	Comp., 1.5 kΩ, ±5%				5905-683-2242
TRANSFORMERS					
T1	Asm	1160-2610	24655	1160-2610	
T2	Asm	1160-2613	24655	1160-2613	
T3	Asm	1160-2611	24655	1160-2611	
TRANSISTORS					
Q1	Type 2N3905	8210-1114	04713	2N3905	
Q2 and Q3	Type 2N3563	8210-1066	07263	2N3563	
Q4 and Q5	Type 2N3903	8210-1132	04713	2N3903	
Q6	Type 2N4275	8210-1126	07263	2N4275	
INDUCTORS					
L2	Asm (BU)	1165-2405	24655	1165-2405	
L3	Asm (RD)	1165-2410	24655	1165-2410	
L4	Asm (VT)	1165-2415	24655	1165-2415	
L5	Asm (YE-RD)	1165-2411	24655	1165-2411	
L6	Asm (BK)	1165-2470	24655	1165-2470	
L7	Asm (VT)	1165-2415	24655	1165-2415	
1169-4065 MIXER/DIVIDER CIRCUIT ASM (JC)					
INTEGRATED CIRCUITS					
U1	Digital, MC1013L	5431-9610	04713	MC1013L	
U2	Digital				



Etched-circuit diagram, Mixer/Divider board -- JA (P/N 1169-4060).

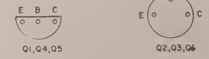
NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.





NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD.

TRANSISTOR BASING
(BOTTOM VIEW)



GROUND TERMINALS 1, 4, 6, 17, 18, 20, 22, 40, 42, 44

NOTE: FOR 1169-4065 CIRCUIT DESIGNATION IS JC.

FOR 1169-4065 APPLICATION, SEE DRAWINGS 1169-4090-2D AND 1169-4092 FOR MATING CONNECTIONS.

Figure 6-19. 5.1 MHz Inter. Mixer JA and JC. (P/N 1169-4060/ -4065)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1165-4018 INPUT MIXER CIRCUIT ASM (LA)					
CAPACITORS					
C1	169 pF ±2%	4700-0443	14655	22A5T15, 169 pF ±2%	
C2	.01 µF +80-20%	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C3	Ceramic, 91 pF ±5% 100 V N030	4411-2000	72982	815, 91 pF ±5%	
C4	.001 µF ±10%	4405-2108	72982	801, .001 µF ±10%	5910-914-0087
C5	.0047 µF ±20%	4405-2470	72982	801, .0047 µF ±20%	
C6	.01 µF +80-29%	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C7	Ceramic, 68 pF ±5% 100 V N150	4413-1000	72982	0855037P20-00680J	
C8	1.2 pF ±5%	4400-0120	78488	GA, 1.2 pF ±5%	
C9	Ceramic, 68 pF ±5% 100 V N150	4413-1000	72982	0855037P20-00680J	
C10	Ceramic, 3.3 pF ±5% 100 V NPO	4410-1200	72982	865, 3.3 pF ±5%	
C11	Ceramic, 68 pF ±5% 100 V N150	4413-1000	72982	0855037P20-00680J	
C12	.01 µF +80-20%	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C13	Ceramic, 68 pF ±5% 100 V N150	4413-1000	72982	0855037P20-00680J	
C14	.68 pF ±10%	4400-0068	78488	GA, .68 pF ±10%	
C15	.01 µF +80-20%	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
CHOKES					
L1	.12 µH ±10%	4300-7525	99800	1025	
L7	8.2 µH ±10%	4300-7558	19376	8.2 µH ±10%	
INDUCTORS					
L3	Asm (RD)	1165-2410	24655	1165-2410	
L4	Asm (VT)	1165-2415	24655	1165-2415	
L5	Asm (RD)	1165-2410	24655	1165-2410	
L6	Asm (GN)	1165-2425	24655	1165-2425	
RESISTORS					
R1	Comp., 300 Ω ±5% 1/4 W	6099-1305	75042	BTS, 300 Ω ±5%	5905-279-5481
R2	Comp., 51 Ω ±5% 1/8 W	6098-0515	01121	BB, 51 Ω ±5%	
R3	Comp., 1.2 kΩ ±5% 1/8 W	6098-2125	01121	BB, 1.2 Ω ±5%	
R4	Comp., 620 Ω ±5% 1/8 W	6098-1625	01121	BB, 620 Ω ±5%	
R5	Comp., 150 Ω ±5% 1/4 W	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
R6	Comp., 18 kΩ ±5% 1/4 W	6099-3185	75042	BTS, 18 kΩ ±5%	5905-687-0000
R7	Comp., 3.3 kΩ ±5% 1/4 W	6099-2335	75042	BTS, 3.3 kΩ ±5%	5905-681-9969
R8	Comp., 470 Ω, ±5%, 1/4 W	6099-1475	75042	BTS, 470 Ω, ±5%	5905-683-2242
R9	Comp., 1.8 kΩ ±5% 1/4 W	6099-2185	75042	BTS, 1.8 kΩ ±5%	5905-688-3738
R10	Comp., 15 kΩ ±5% 1/4 w	6099-3155	75042	BTS, 15 kΩ ±5%	5905-681-8818
R11	Comp., 120 Ω ±5% 1/4 W	6099-1125	75042	BTS, 120 Ω ±5%	
R12	Pot. Cermet, 200 Ω ±10%	6049-0293	01121	ZH2011	
TRANSFORMERS					
T1	Transformer Asm	1160-2610	24655	1160-2610	
TRANSISTORS					
Q1	Type 2N3905	04713	2N3905		
Q2	Type 2N3563	8210-1066	07263	2N3563	
Q3	Type 2N5179	8210-1195	79089	2N5179	

RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS, $\mu=10^{-6}$, $p=10^{-12}$
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
PANEL CONTROL ▭ REAR CONTROL
SCREWDRIVER CONTROL WT=WIRE TIE TP=TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-R1, B-R1, ETC

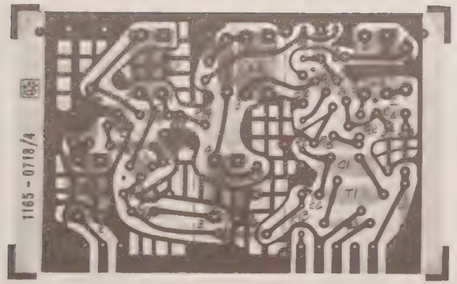
4 0 4 F SWITCH NUMBERING
- FRONT-REAR
- CONTACTS: FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
- SECTION: SECTION NEAREST PANEL IS 1.

ROTORS SHOWN CCW

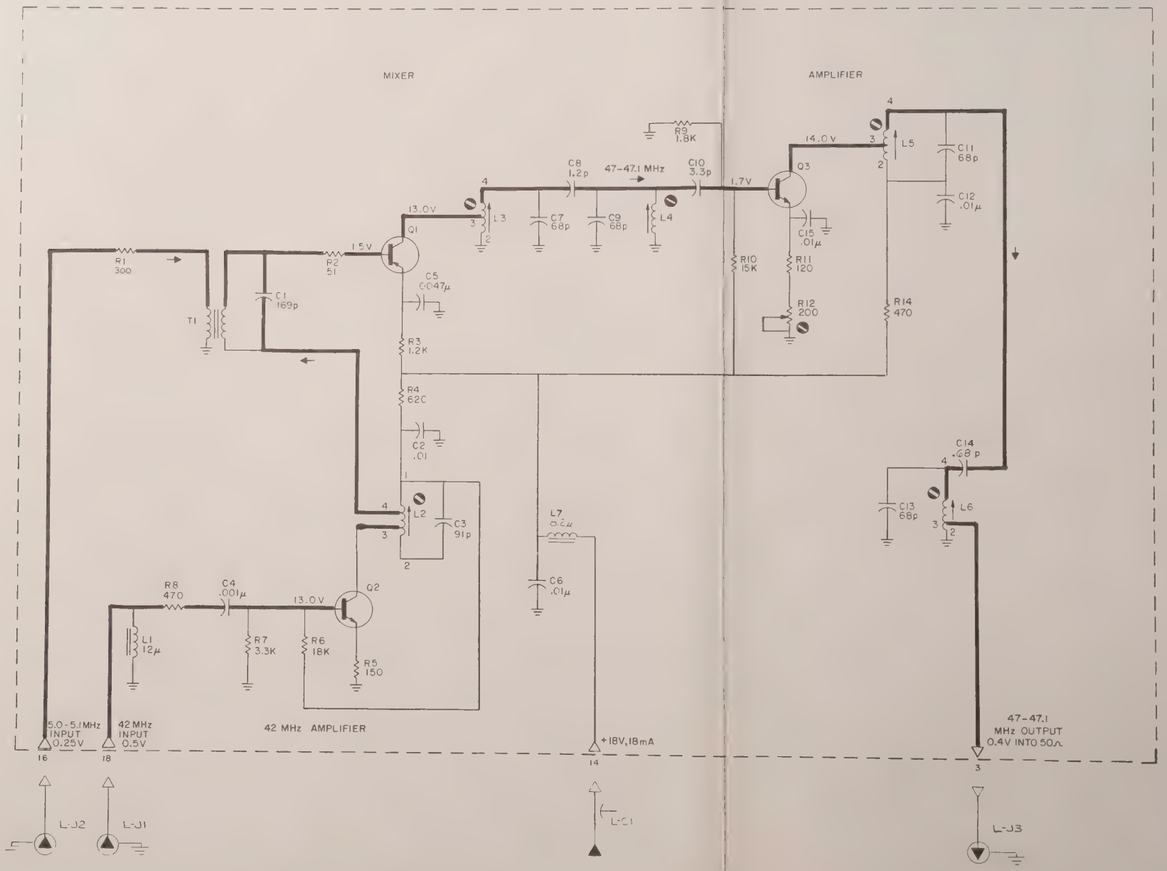
CONNECTIONS
- OUTPUT LEAVES SUBASSEMBLY
- INPUT FROM DIFFERENT SUBASSEMBLY
- OUTPUT REMAINS ON SUBASSEMBLY
- INPUT FROM SAME SUBASSEMBLY

NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF



NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



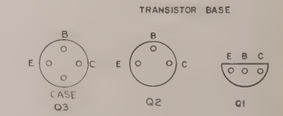
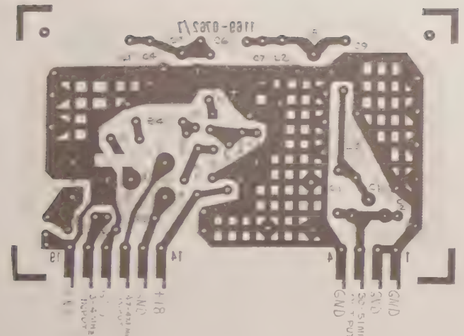


Figure 6-20. Intermediate Mixer (47-MHz) I.A. (P/N 1165-4018)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4062 INTERMEDIATE MIXER BOARD (MB)					
CAPACITORS					
C1 thru C3	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C4	Ceramic, 51 pF ±5% 500 V N030	4411-0515	80131	CC62, 51 pF ±5%	
C5	Trimmer, 7-25 pF	4910-2032	72982	538-006, 7 to 25 pF	5910-998-1621
C6	Ceramic, 2.2 pF ±5% 500 V	4400-0205	78488	GA, 2.2 pF ±5%	5910-667-6114
C7	Ceramic, 51 pF ±5% 500 V N030	4411-0515	80131	CC62, 51 pF ±5%	
C8	Trimmer, 7-25 pF	4910-2032	72982	528-006, 7 to 25 pF	5910-998-1621
C9	Ceramic, 1.5 pF ±5% 500 V	4400-0150	78488	GA, 1.5 pF ±5%	
C10	Trimmer, 7-25 pF	4910-2032	72982	538-006, 7 to 25 pF	5910-998-1621
C11	Ceramic, 62 pF ±5% 500 V N030	4411-0625	72982	811, 62 pF ±5%	
C12	Mica, 270 pF ±1% 500 V	4710-0450	14655	22A, 270 pF ±1%	
CHOKES					
L1 thru L3	Molded, 0.15 µH ±10%	4300-0101	99800	1536	
CONNECTORS					
	Signal Jack	4260-1830	00528	#1707MT-025-1	
INTEGRATED CIRCUITS					
U1	Mixer, Type M6D	5434-0100	23367	1116D	
RESISTORS					
R1	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R2	Comp., 24 Ω ±5% 1/4 W	6099-0245	75042	BTS, 24 Ω ±5%	
R3	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R4	Comp., 39 Ω ±5% 1/4 W	6099-0395	75042	BTS, 39 Ω ±5%	
R5	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R6	Comp., 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R7	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ	5905-683-2238
R8	Comp., 8.2 kΩ ±5% 1/4 W	6099-2825	75042	BTS, 8.2 kΩ ±5%	
R9	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
TRANSISTORS					
Q1	Type 2N3905	8?10-1114	04713	2N3905	



Etched-circuit diagram, Intermediate mixer board — MB (P/N 1169-4062).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

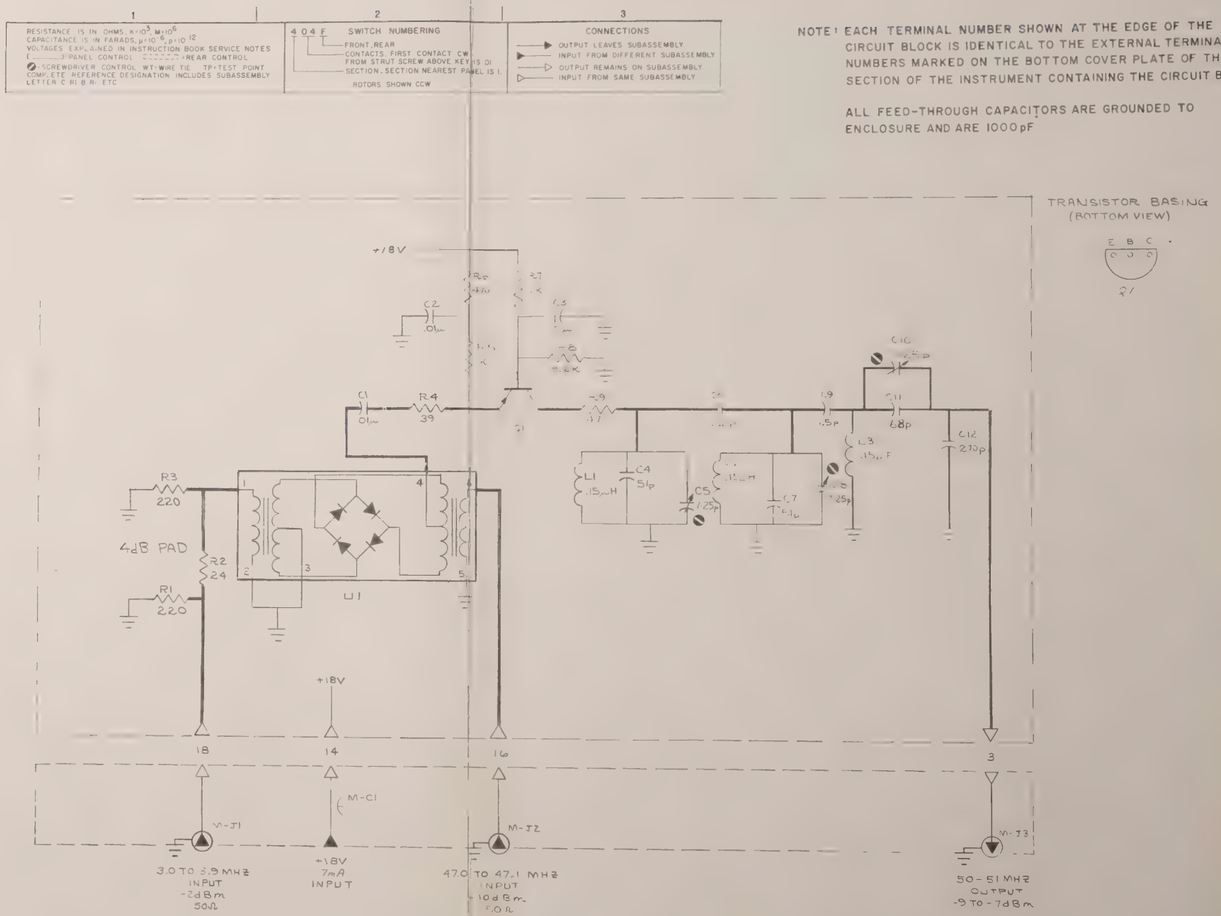


Figure 6-21. Intermediate mixer (51 MHz) MB (P/N 1169-4062)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
1158-4010	OSCILLATOR			
	OSCILLATOR ASM	1158-4010	24655	1158-4010

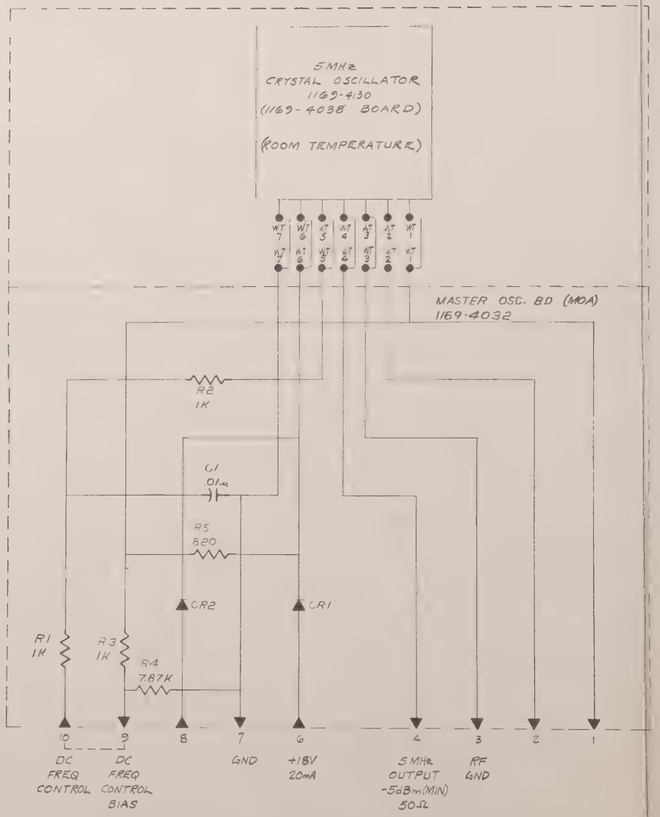


Figure 6-22. Moderate stability oscillator unit MO-10C. (P/N 1169-4131)

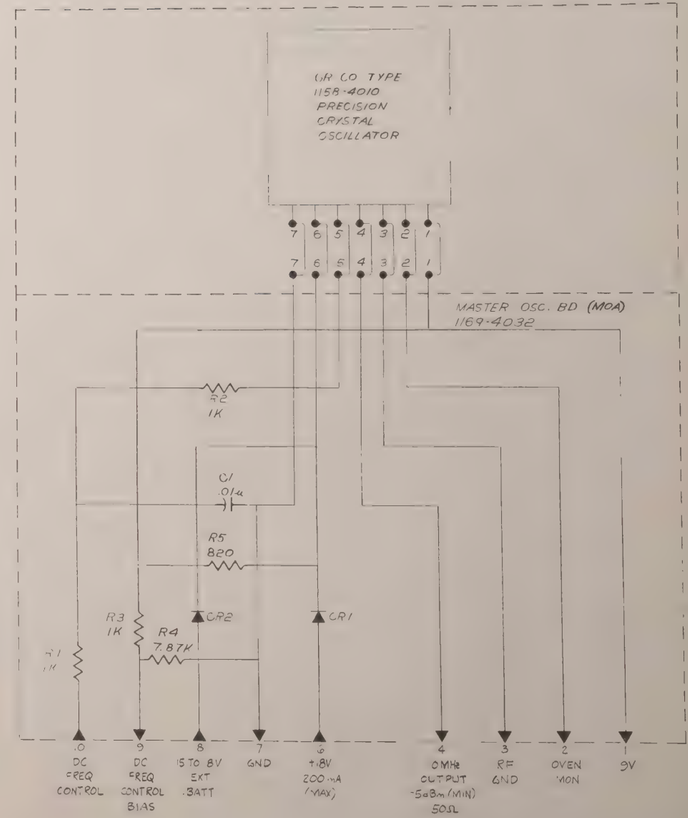


Figure 6-23. High stability Master oscillator unit MO-10B. (P/N 1169-4033)

ELECTRICAL PARTS LIST

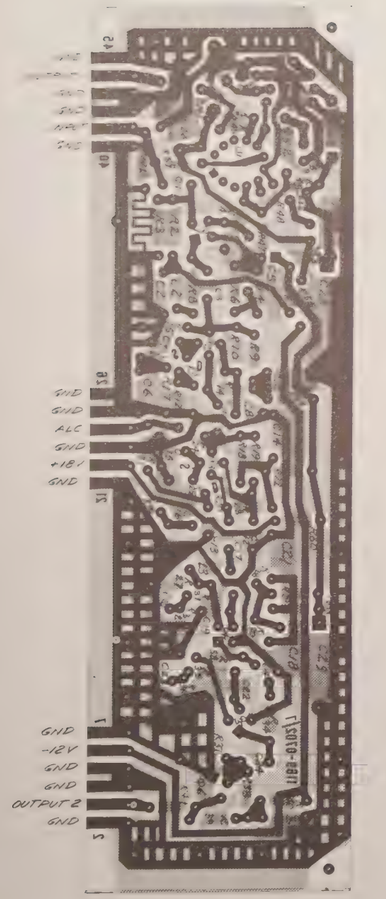
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4002 OUTPUT AMPLIFIER BOARD (OAA)					
CAPACITORS					
C1	Ceramic, 1000 pF ±10% 500 V	4404-2108	72982	831, 1000 pF ±10%	
C2	Ceramic, 0.22 µF ±20% 50 V	4400-2052	80183	5C13, .22 µF ±20%	5910-974-5694
C3	Ceramic, 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C4	Mica, 47 pF ±5% 500 V	4700-0247	14655	22H5Q47	
C5 and C6	Ceramic, 0.22 µF ±20% 50 V	4400-2052	80183	5C13, .22 µF ±20%	5910-974-5694
C7 and C8	Ceramic, 220 pF ±10% 500 V	4404-1228	72982	831, 220 pF ±5%	
C9	Ceramic, 1000 pF ±10% 500 V	4404-2108	72982	831, 1000 pF ±10%	
C10	Ceramic, 0.22 µF ±20% 50 V	4400-2052	80183	5C13, .22 µF ±20%	5910-974-5694
C11	Ceramic, 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C12	Ceramic, 220 pF ±10% 500 V	4404-1228	72982	831, 220 pF ±5%	
C13	Ceramic, 470 pF ±10% 500 V	4404-1478	72982	831, 470 pF ±10%	
C14	Ceramic, 0.22 µF ±20% 50 V	4400-2052	80183	5C13, .22 µF ±20%	5910-974-5694
C15	Ceramic, 220 pF ±10% 500 V	4404-1228	72982	831, 220 pF ±5%	
C16	Ceramic, 0.22 µF ±20% 50 V	4400-2052	80183	5C13, .22 µF ±20%	5910-974-5694
C17	Ceramic, 1000 pF ±10% 500 V	4404-2108	72982	831, 1000 pF ±10%	
C18	Ceramic, 0.22 µF ±20% 50 V	4400-2052	80183	5C13, .22 µF ±20%	5910-974-5694
C19	Ceramic, 56 pF ±5% 500 V	4404-0565	72982	831, 56 pF ±5%	
C20 and C21	Ceramic, 0.22 µF ±20% 50 V	4400-2052	80183	5C13, .22 µF ±20%	5910-974-5694
C22	Ceramic, 56 pF ±5% 500 V	4700-0315	88419	22A5Q51	
C23	Ceramic, 0.22 µF ±20% 50 V	4400-2052	80183	5C13, .22 µF ±20%	5910-974-5694
C24	Ceramic, 1000 pF ±10% 500 V	4404-2108	72982	831, 1000 pF ±10%	
C25	Ceramic, 1 µF ±20% 50 V	4400-2070	80183	5C13, 1 µF ±20%	5910-085-6445
C26	Tantalum, 22.0 µF ±20% 15 V	4450-5300	56289	150D226X0015B2	5910-752-4270
C27	Ceramic Tubular, 5.16 F ±5% 500 V	4400-0511	23680	5.16 F ±5%	
C28	Tantalum, 33 µF ±20% 20 V	4450-5613	80183	150D336X0020R2	
C29	Tantalum, 15.0 µF ±20% 20 V	4450-5200	56289	150D156X0020B2	5910-855-6335
CHOKES					
L2	Molded, .22 µH ±10%	4300-7551	72259	1025	
L3	Molded, .12 µH ±10%	4300-7552	72259	1537	
L4	Molded, 0.18 µH ±10%	4300-7554	72259	1537	
DIODES					
CR1	Type 1N957A	6083-1009	07910	1N957A	
VR2	Type 1N748A	6083-1002	07910	1N748A	5960-800-3973
VR3	Type 1N957A	6083-1009	07910	1N957A	
INTEGRATED CIRCUITS					
U1	Type CA3049	5432-1037	06704	CA3049	
RESISTORS					
R1	Film, 50 Ω ±0.5% 100 1/8 W	6619-3300	75042	WW3J, 50 Ω ±0.5%	
R2	Film, 16.2 kΩ ±1% 1/8 W	6250-2162	75042	CEA, 16.2 kΩ ±1%	
R3	Film, 4.75 kΩ ±1% 1/8 W	6250-1475	75042	CEA, 4.75 kΩ ±1%	
R4	Film, 37.4 Ω ±1% 1/8 W	6250-9374	75042	CEA, 37.4 Ω ±1%	5905-878-2676
R6	Comp., 360 Ω ±5% 1/4 W	6099-1365	75042	BTS, 360 Ω ±5%	
R7	Comp., 1.2 kΩ ±5% 1/4 W	6099-2125	75042	BTS, 1.2 kΩ ±5%	
R8	Film, 221 Ω ±1% 1/8 W	6250-0221	75042	CEA, 221 Ω ±1%	
R9	Comp., 120 kΩ ±5% 1/4 W	6099-4125	75042	BTS, 120 kΩ ±5%	5905-686-9993
R10	Comp., 82 kΩ ±5% 1/4 W	6099-3825	75042	BTS, 82 kΩ ±5%	
R11	Comp., 1 kΩ ±5% 1/4 W	6099-2105	01121	RC20GF102J	5905-681-6422
R12	Comp., 24 kΩ ±5% 1/4 W	6099-3245	75042	BTS, 24 kΩ ±5%	
R13	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R14	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R15	Comp., 39 kΩ ±5% 1/4 W	6099-3395	75042	BTS, 39 kΩ ±5%	5905-686-3358
R16	Comp., 24 Ω ±5% 1/4 W	6099-0245	75042	BTS, 24 Ω ±5%	
R17	Comp., 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R18	Comp., 180 kΩ ±5% 1/4 W	6099-4185	75042	BTS, 180 kΩ ±5%	
R19	Comp., 43 kΩ ±5% 1/4 W	6099-3435	75042	BTS, 43 kΩ ±5%	5905-549-9833
R20	Comp., 1 kΩ ±5% 1/4 W	6099-2105	01121	RC20GF102J	5905-681-6422
R21	Comp., 16 kΩ ±5% 1/4 W	6099-3165	75042	BTS, 16 kΩ ±5%	
R22	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R23	Comp., 180 Ω ±5% 1/4 W	6099-1185	75042	BTS, 180 Ω ±5%	5905-682-4107
R24	Comp., 39 kΩ ±5% 1/4 W	6099-3395	75042	BTS, 39 kΩ ±5%	5905-686-3358
R25	Comp., 33 Ω ±5% 1/4 W	6099-0335	75042	BTS, 33 Ω ±5%	
R26	Comp., 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R27	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R28	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R29	Comp., 750 Ω ±5% 1/4 W	6099-1755	01121	RC29GF751J	5905-195-9481
R30	Comp., 200 Ω ±5% 1/4 W	6099-1205	75042	BTS, 200 Ω ±5%	5905-683-2239
R31	Comp., 39 Ω ±5% 1/4 W	6099-0395	75042	BTS, 39 Ω ±5%	
R32	Comp., 330 Ω ±5% 1/4 W	6099-1335	75042	BTS, 330 Ω ±5%	5905-686-3369
R33	Comp., 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R34	Comp., 180 Ω ±5% 1/4 W	6099-1185	75042	BTS, 180 Ω ±5%	5905-682-4107
R35	Comp., 51 Ω ±5% 1/4 W	6099-0515	75042	BTS, 51 Ω ±5%	
R36	Comp., 360 Ω ±5% 1/4 W	6099-1365	75042	BTS, 360 Ω ±5%	
R37 and R38	Comp., 2.4 kΩ ±5% 1/4 W	6099-2245	75042	BTS, 2.4 kΩ ±5%	5905-683-7724
R39	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R40	Comp., 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R41	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R42 and R43	Comp., 1.2 kΩ ±5% 1/4 W	6099-2125	75042	BTS, 1.2 kΩ ±5%	
R44	Comp., 1.3 kΩ ±5% 1/4 W	6099-2135	75042	BTS, 1.3 kΩ ±5%	5905-686-3119
R45	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R46	Comp., 910 Ω ±5% 1/4 W	6099-1915	75042	BTS, 910 Ω ±5%	
R47	Film, 51.1 Ω ±1% 1/8 W	6250-9511	75042	CEA, 51.1 Ω ±1%	5905-552-3477
R48	Comp., 47 kΩ ±5% 1/4 W	6099-3475	75042	BTS, 47 kΩ ±5%	5905-683-2246
R49	Pot. Cermet, 25 kΩ ±20%	6049-0319	24655	6049-0319	
R50	Comp., 1 kΩ ±5% 1/4 W	6099-2105	01121	RC20GF102J	5905-681-6422
R51	Comp., 24 Ω ±5% 1/4 W	6099-0245	75042	BTS, 24 Ω ±5%	
R52	Film, 825 Ω ±1% 1/8 W	6250-0825	75042	CEA, 825 Ω ±1%	5905-702-4172
R53	Pot. Cermet, 1 kΩ ±20%	6049-0314	24655	6049-0314	
R54	Comp., 680 Ω ±5% 1/2 W	6100-1685	01121	RC20GF681F	5905-195-6791
R55 and R56	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R58 and R59	Comp., 10 Ω, ±5† 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R60	Comp., 4.7 Ω ±5% 1/4 W	6099-9475	75042	BTS, 4.7 Ω ±5%	
TRANSISTORS					
Q1	Type A485	8210-1194	03715	A485	
Q2 and Q3	Type 3N159	8210-1193	79089	3N159	
Q4	Type 2N3478	8210-1111	79089	2N3478	
Q5	Type A436	8210-1228	73445	A430	
Q6	Type 5109	8210-1198	79089	5109	
Q7	Type 2N3546	8210-1140	04713	2N3546	

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
TRAY ASM				
CAPACITORS				
C1 thru C4		1165-8770	24655	1165-8770
L1 and L2	Toroid Core	5000-1255	24655	5000-1255
CONNECTORS				
J1 thru J4	RF Insert	1165-6020	24655	1165-6020
SO1	Contact Strip Asm	1165-1820	24655	1165-1820
SO2	Contact Strip Asm	1165-1826	24655	1165-1826
SO3 and SO4	Contact Strip Asm	1165-1820	24655	1165-1820
SO5	Contact Strip Asm	1165-1832	24655	1165-1832
SO6	Contact Strip Asm	1165-1820	24655	1165-1820



Etched-circuit diagram, Output Amplifier board — OAA (P/N 1169-4002).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

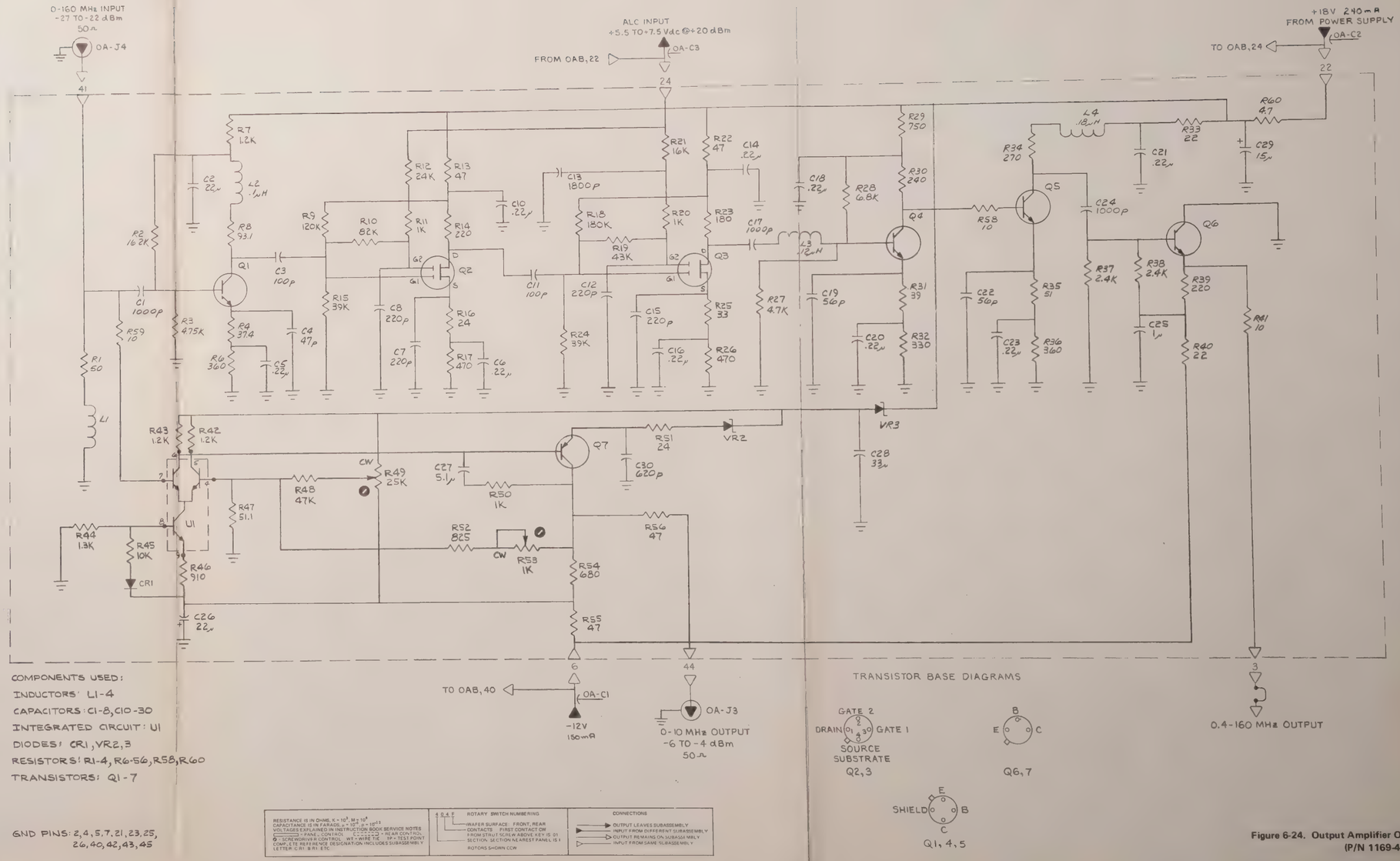


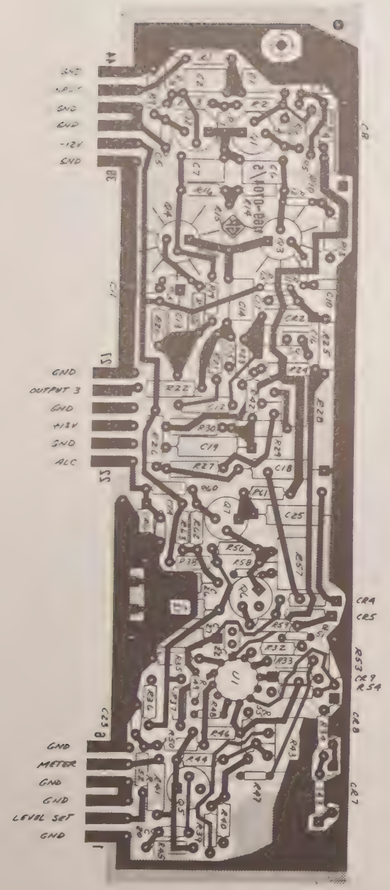
Figure 6-24. Output Amplifier OAA. (P/N 1169-4002)

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4004 OUTPUT AMPLIFIER BOARD (OAB)					
CAPACITORS					
C1 and					
C2	Ceramic, 0.1 µF ±20% 50 V	4400-2050	80183	5C13, .1 µF ±20%	5910-080-4646
C3	Ceramic, 1.0 µF ±20% 50 V	4400-2070	80183	5C13, .1 µF ±20%	5910-083-6445
C4 and					
C5	Ceramic, 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C6 and					
C7	Ceramic, 0.1 µF ±20% 50 V	4400-2050	80183	5C13, .1 µF ±20%	5910-080-4646
C8	Tantalum, 6.8 µF ±20% 35 V	4450-5000	56289	150D685X0035B2	5910-814-5869
C10 and					
C11	Ceramic, 68 pF ±5% 500 V	4404-0685	72982	831, 68 pF ±5%	
C12	Ceramic, 1.0 µF ±10% 500 V	4400-0100	78488	GA, 1.0 µF ±10%	5910-034-5367
C13	Tantalum, 6.8 µF ±20% 35 V	4450-5000	56289	150D685X0035B2	5910-814-5869
C14	Ceramic, 1.0 µF ±20% 50 V	4400-2070	80183	5C13, 1 µF ±20%	5910-083-6445
C15	Ceramic, 470 pF ±10% 500 V	4404-1478	72982	831, 470 pF ±10%	
C16	Ceramic, .01 µF ±10% 50 V	4400-6351	72982	8121-050-W5R-103K	
C17	Ceramic, 470 pF ±10% 500 V	4404-1478	72982	831, 470 pF ±10%	
C18 and					
C19	Tantalum, 6.8 µF ±20% 35 V	4450-5000	56289	150D685X0035B2	5910-814-5869
C20	Ceramic, 27 pF ±10% 500 V	4404-0278	72982	831, 27 pF ±10%	
C21	Tantalum, 6.8 µF ±20% 35 V	4450-5000	56289	150D685X0035B2	5910-814-5869
C22	Ceramic, .01 µF ±10% 50 V	4400-6351	72982	8121-050-W5R-103K	
C23	Ceramic, 1000 pF ±10% 500 V	4404-2108	72982	831, .001 µF ±10%	5910-914-0087
C24	Ceramic, .033 µF ±10% 50 V	4400-6354	72982	8131-M050-W5R-333K	
C25 thru					
C27	Tantalum, 6.8 µF ±20% 35 V	4450-5000	56289	150D685X0035B2	5910-814-5869
DIODES					
CR1 and					
CR2	Type 5082-2800	6082-1034	28480	5082-2800	
CR4	Type 1N957B	6083-1009	07910	1N957B	
CR5	Type 1N4009	6082-1012	24446	1N4009	5961-892-8700
CR6	Type 1N959B	6083-1010	72699	1N959B	
INTEGRATED CIRCUITS					
U1	Type CA3049	5432-1037	06704	CA3049	
RESISTORS					
R1	Comp., 12 Ω ±5% 1/4 W	6099-0125	75042	BTS, 12 Ω ±5%	5905-806-0633
R2 and					
R3	Comp., 910 Ω ±5% 1/4 W	6099-1915	75042	BTS, 910 Ω ±5%	
R4	Comp., 4.7 Ω ±5% 1/4 W	6099-9475	75042	BTS, 4.7 Ω ±5%	5905-686-9992
R5	Comp., 240 Ω ±5% 1/4 W	6099-1245	75042	BTS, 240 Ω ±5%	
R6	Comp., 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R7	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R8	Comp., 240 Ω ±5% 1/4 W	6099-1245	75042	BTS, 240 Ω ±5%	
R9	Comp., 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R10	Comp., 4.7 Ω ±5% 1/4 W	6099-9475	75042	BTS, 4.7 Ω ±5%	5905-686-9992
R11	Comp., 10 Ω ±5% 1/8 W	6098-0105	01121	BB, 10 Ω ±5%	
R12	Comp., 240 Ω ±5% 1/8 W	6098-1245	01121	BB, 240 Ω ±5%	
R13	Comp., 24 Ω ±5% 1/4 W	6099-0245	75042	BTS, 24 Ω ±5%	
R14	Comp., 1.2 kΩ ±5% 1/4 W	6099-2125	75042	BTS, 1.2 kΩ ±5%	
R15	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R16	Comp., 1.2 kΩ ±5% 1/4 W	6099-2125	75042	BTS, 1.2 kΩ ±5%	
R17	Comp., 240 Ω ±5% 1/4 W	6099-1245	75042	BTS, 240 Ω ±5%	
R18	Comp., 24 Ω ±5% 1/4 W	6099-0245	75042	BTS, 24 Ω ±5%	
R19	Comp., 240 Ω ±5% 1/4 W	6099-1245	75042	BTS, 240 Ω ±5%	
R20	Comp., 4.7 Ω ±5% 1/4 W	6099-9475	75042	BTS, 4.7 Ω ±5%	5905-686-9992
R21	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R22	Film, 50 Ω ±5% 1/20 W	6619-3300	75042	WW3J, 50 Ω ±5%	
R23	Comp., 68 Ω ±5% 1/4 W	6099-0685	75042	BTS, 68 Ω ±5%	
R24	Comp., 36 k ±5% 1/4 W	6099-3365	75042	BTS, 36 k ±5%	5905-683-7726
R25	Comp., 91 kΩ ±5% 1/4 W	6099-3915	75042	BTS, 91 kΩ ±5%	5905-726-3807
R26	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
R27	Comp., 20 kΩ ±5% 1/4 W	6099-3205	75042	BTS, 20 kΩ ±5%	5905-686-3368
R28	Pot. Comp., 5 kΩ ±20% 1/4 W	6040-0600	01121	FWC, 5 kΩ ±20%	5905-034-5374
R29	Comp., 30 kΩ ±5% 1/4 W	6099-3305	75042	BTS, 30 kΩ ±5%	5905-803-2908
R30	Comp., 2.4 kΩ ±5% 1/4 W	6099-2245	75042	BTS, 2.4 kΩ ±5%	5905-683-7724
R32	Comp., 33 kΩ ±5% 1/4 W	6099-3335	75042	BTS, 33 kΩ ±5%	
R33	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R34	Comp., 39 kΩ ±5% 1/4 W	6099-3395	75042	BTS, 39 kΩ ±5%	5905-686-3358
R35	Comp., 2.7 kΩ ±5% 1/4 W	6099-2275	75042	BTS, 2.7 kΩ ±5%	
R36	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	5905-687-0002
R37	Comp., 20 kΩ ±5% 1/4 W	6099-3205	75042	BTS, 20 kΩ ±5%	5905-686-3368
R38	Comp., 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389

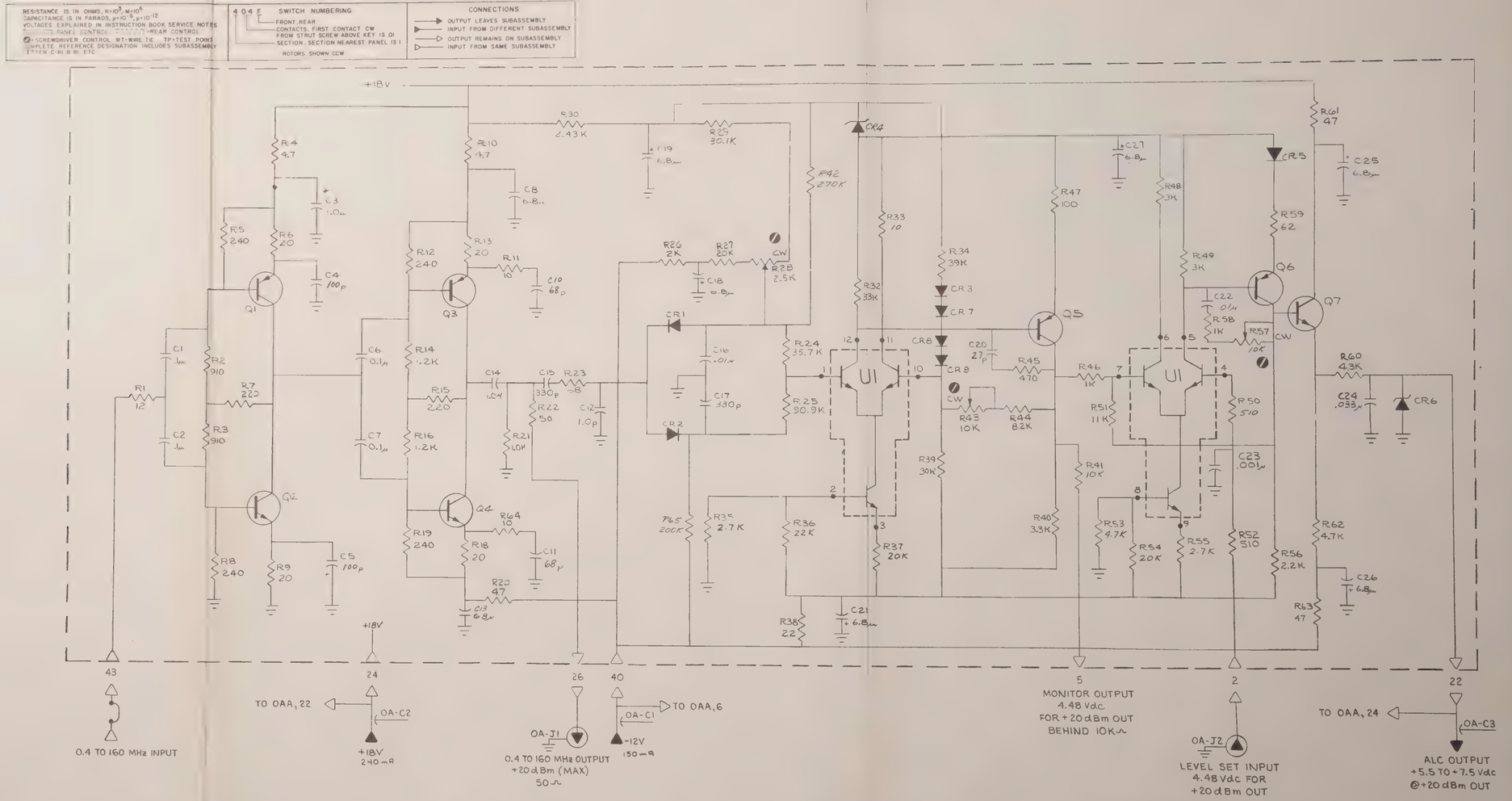
ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R39	Comp., 30 kΩ ±5% 1/4 W	6099-3305	75042	BTS, 30 kΩ ±5%	5905-803-2908
R40	Comp., 3.3 kΩ ±5% 1/4 W	6099-2335	75042	BTS, 3.3 kΩ ±5%	5905-681-9969
R41	Film, 10 kΩ ±1% 1/8 W	6250-2100	75042	CEA, 10 kΩ ±1%	5905-883-4847
R42	Comp., 270 k ±5% 1/4 W	6099-4275	75042	BTS, 270 k ±5%	
R43	Pot. Comp., 10 kΩ ±20% 1/4 W	6040-0700	01121	FWC, 10 kΩ ±20%	5905-549-2773
R44	Comp., 8.2 kΩ ±5% 1/4 W	6099-2825	75042	BTS, 8.2 kΩ ±5%	
R45	Comp., 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R46	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R47	Comp., 100 Ω ±5% 1/8 W	6098-1105	01121	BB, 100 Ω ±5%	
R48 and					
R49	Comp., 3 kΩ ±5% 1/8 W	6098-2305	01121	BB, 3 kΩ ±5%	
R50	Comp., 510 Ω ±5% 1/4 W	6099-1515	75042	BTS, 510 Ω ±5%	5905-801-8272
R51	Comp., 30 kΩ ±5% 1/8 W	6098-3305	01121	BB, 30 kΩ ±5%	
R52	Comp., 510 Ω ±5% 1/4 W	6099-1515	75042	BTS, 510 Ω ±5%	5905-801-8272
R53	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R54	Comp., 20 kΩ ±5% 1/4 W	6099-3205	75042	BTS, 20 kΩ ±5%	5905-686-3368
R55	Comp., 2.7 kΩ ±5% 1/4 W	6099-2275	75042	BTS, 2.7 kΩ ±5%	
R56	Comp., 2.2 kΩ ±5% 1/4 W	6099-2225	75042	BTS, 2.2 kΩ ±5%	5905-723-5251
R57	Pot. Comp., 10 kΩ ±20% 1/4 W	6040-0700	01121	FWC, 10 kΩ ±20%	5905-549-2773
R58	Comp., 1 kΩ ±5% 1/8 W	6098-2105	01121	BB, 1 kΩ ±5%	
R59	Comp., 62 Ω ±5% 1/4 W	6099-0625	75042	BTS, 62 Ω ±5%	
R60	Comp., 3.3 kΩ ±5% 1/4 W	6099-2335	75042	BTS, 3.3 kΩ ±5%	5905-681-9969
R61	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R62	Comp., 4.7 Ω ±5% 1/4 W	6099-9475	75042	BTS, 4.7 Ω ±5%	5905-686-9992
R63	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R64	Comp., 10 Ω ±5% 1/8 W	6098-0105	01121	BB, 10 Ω ±5%	
R65	Comp., 200 K ±5% 1/8 W	6098-4205	01121	BB, 200 KΩ ±5%	
TRANSISTORS					
Q1	Type 2N5160	8210-1199	04713	2N5160	
Q2	Type 2N3866	8210-1120	79089	2N3866	
Q3	Type 2N5160	8210-1199	04713	2N5160	
Q4	Type 2N3866	8210-1120	79089	2N3866	
Q5 and					
Q6	Type 2N2904	8210-1074	07263	2N2904	



Etched-Circuit diagram, Output Amplifier board – OAB (P/N 1169-4004).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



GROUND PINS:
1, 3, 4, 6, 23, 25, 27, 39, 41, 42, 44

COMPONENTS USED:
CAPACITORS: C1-8, C10-27
INTEGRATED CIRCUIT: U1
DIODES: CR1-9
RESISTORS: R1-16, R18-30, R32-65
TRANSISTORS: Q1-7

NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD.

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000pF

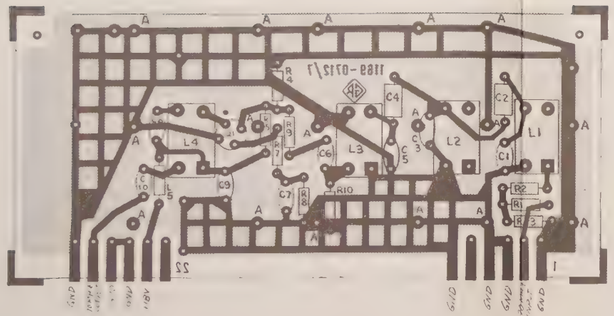
TRANSISTOR BASING DIAGRAM
(BOTTOM VIEW)

Q1, 2, 3, 4, 5, 6, 7

Figure 6-25. Output Amplifier OAB. (P/N 1169-4004)

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4012 70 MHz AMPLIFIER BOARD (PD)					
CAPACITORS					
C1	24 pF ±5%	4411-2006	72982	831, 24 pF ±5%	
C2	1 pF ±10%	4400-0100	78488	GA, 1 pF ±10%	5910-034-5367
C3	24 pF ±5%	4411-2006	72982	831, 24 pF ±5%	
C4	1 pF ±10%	4400-0100	78488	GA, 1 pF ±10%	5910-034-5367
C5	24 pF ±5%	4411-2006	72982	831, 24 pF ±5%	
C6	470 pF ±10%	4404-1478	72982	831, 470 pF ±10%	
C7	.991 µF +80-20%	4404-2109	72982	831, .001 µF +80-20%	
C8	24 pF ±5%	4411-2006	72982	831, 24 pF ±5%	
C9	.01 µF +80-20%	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C10	470 pF ±10%	4404-1478	72982	831, 470 pF ±10%	
INDUCTORS					
L1 and L2		1165-2200	24655	1165-2200	
L3	1165-2205	1165-2205	24655	1165-2205	
L4		1165-2210	24655	1165-2210	
RESISTORS					
R1 and R2	10 Ω ±5%	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R3	150 Ω ±5%	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
R4	4.7 kΩ ±5%	6099-2475	75042	BTS, 470 Ω ±5%	5905-683-2242
R5	12 kΩ ±5%	6099-3125	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R6	100 Ω ±5%	6099-1105	75042	BTS, 100 Ω ±5%	
R7	15 Ω ±5%	6099-0155	75042	BTS, 15 Ω ±5%	
R8	470 Ω ±5%	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
R9	10 Ω ±5%	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
R10	100 Ω ±5%	6099-1105	75042	BTS, 100 Ω ±5%	
TRANSISTORS					
Q1	Type 2N5179	8210-1195	79089	2N5179	



Etched-circuit diagram, Phase modulator input — PD (P/N 1169-4012).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

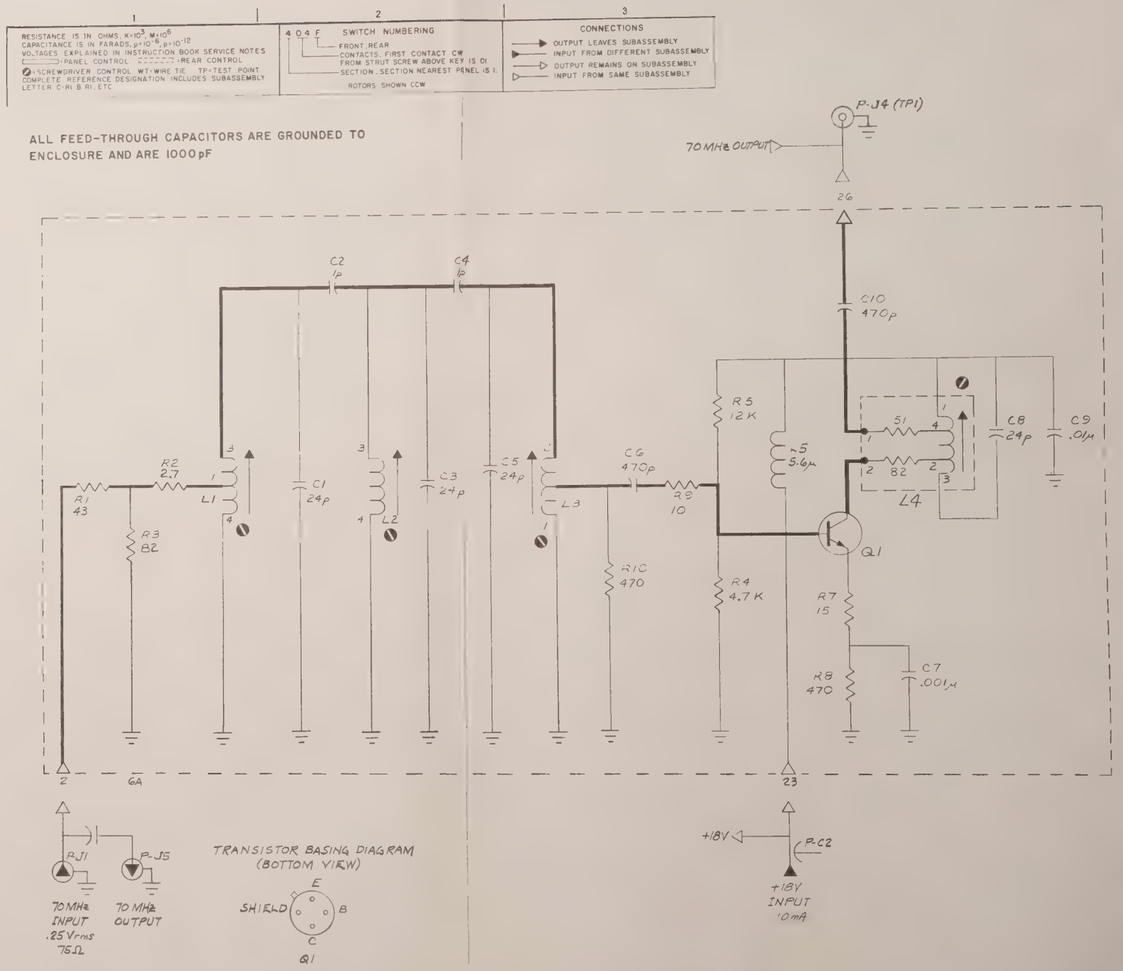


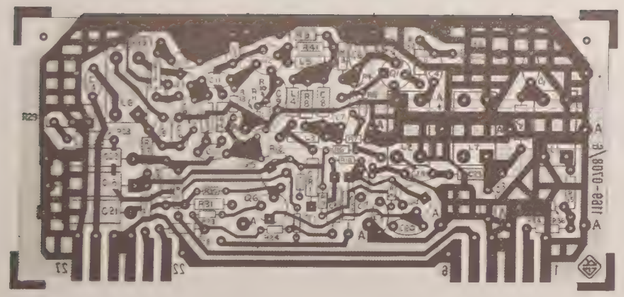
Figure 6-26. Phase modulator input amplifier PD. (P/N 1169-4012)

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4008 70 MHz PHASE MODULATOR ASM (PC)					
CAPACITORS					
C1	Ceramic, .24 pF ±5% 100 V	4411-2006	72982	831, 24 pF ±5%	
C2	Ceramic, .82 pF ±5%	4400-1240	78488	GA, 82 pF ±5%	
C3	Ceramic, .24 pF ±5% 100 V	4411-2006	72982	831, 24 pF ±5%	
C4	Ceramic, .001 µF ±10% 100 V	4404-2108	72982	831, .001 µF ±5%	
C5 and C6	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C7	Ceramic, 100 pF ±5% 100 V	4404-1105	72982	831, 100 pF ±5%	
C8	Ceramic, 3.6 pF ±5% 500 V	4400-0500	78488	GA, 3.6 pF ±5%	
C9	Ceramic, .001 µF ±10% 100 V	4404-2108	72982	831, .001 µF ±5%	
C10	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C11	Ceramic, 47 pF ±5% 500 V	4404-0475	72982	831, 47 pF ±5%	
C12 thru C14	Ceramic, 470 pF ±10% 500 V	4404-1478	72982	831, 470 pF ±10%	
C15	Ceramic, 24 pF ±5% 100 V	4411-2006	56289	150D156X0020B2	5910-855-6335
C16 and C17	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C18	Tantalum, 15 µF ±20% 20 V	4450-5200	56289	150D156X0020B2	5910-855-6335
C20	Ceramic, 24 pF ±5% 100 V	4411-2006	72982	831, 24 pF ±5%	
C21	Tantalum, 18 µF ±20% 15 V	4450-5230	56289	150D186X001B2	
C22	Tantalum, 22 µF ±20% 15 V	4450-5300	56289	150D226X0015B2	5910-752-4270
C23	Ceramic, .82 pF ±5% 500 V	4400-1240	78488	GA, 82 pF ±5%	
C24	Ceramic, 24 pF ±5% 100 V	4411-2006	72982	831, 24 pF ±5%	
CHOKES					
L3 and L4	Molded, .68 µH ±10%	4300-7522	99800	.68 µF ±10%	
L5	Molded, .82 µH ±10%	4300-7524	99800	.82 µH ±10%	
DIODES					
CR1 and CR2	Type 1N5148	6084-1016	00434	1N5148	
CR3	Type 1N752A	6083-1004	07910	1N752A	
FERRITE					
L8	Ferrite Bead	5000-1250	24655	5000-1250	
INDUCTOR ASMS:					
L1	(BR)	1165-2200	24655	1165-2200	
L2	(RD)	1165-2205	24655	1165-2205	
L6	(OR)	1165-2210	24655	1165-2210	
L7	(RD)	1165-2205	24655	1165-2205	
RESISTORS					
R2	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
R3	Comp., 8.2 kΩ ±5% 1/4 W	6099-2825	75042	BTS, 8.2 kΩ ±5%	
R4	Comp., 18 kΩ ±5% 1/8 W	6098-3185	01121	BB, 18 kΩ ±5%	
R5	Comp., 820 Ω ±5% 1/8 W	6098-1825	01121	BB, 820 Ω ±5%	
R6	Comp., 47 Ω ±5% 1/8 W	6098-0475	01121	BB, 47 Ω ±5%	
R7	Comp., 200 Ω ±5% 1/8 W	6098-1205	01121	BB, 200 Ω ±5%	
R8	Comp., 330 Ω ±5% 1/4 W	6099-1335	75042	BTS, 330 Ω ±5%	5905-686-3369
R9	Comp., 160 Ω ±5% 1/4 W	6099-1165	75042	BTS, 160 Ω ±5%	
R10	Comp., 39 kΩ ±5% 1/8 W	6098-3395	01121	BB, 39 kΩ ±5%	
R11	Comp., 130 kΩ ±5% 1/8 W	6098-4135	01121	BB, 130 kΩ ±5%	
R12	Comp., 47 Ω ±5% 1/8 W	6098-0475	01121	BB, 47 Ω ±5%	
R13	Comp., 1 kΩ ±5% 1/8 W	6098-2105	01121	BB, 1 kΩ ±5%	
R14	Comp., 1.8 kΩ ±5% 1/4 W	6099-2185	75042	BTS, 1.8 kΩ ±5%	5905-688-3738
R15	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R16	Comp., 12 kΩ ±5% 1/8 W	6098-3125	01121	BB, 12 kΩ ±5%	
R17	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R18	Comp., 510 Ω ±5% 1/4 W	6099-1515	75042	BTS, 510 Ω ±5%	5905-801-8272
R19	Comp., 110 Ω ±5% 1/8 W	6098-1115	01121	BB, 110 Ω ±5%	
R20	Comp., 1.2 kΩ ±5% 1/8 W	6098-2125	01121	BB, 1.2 kΩ ±5%	
R21	Comp., 33 Ω ±5% 1/4 W	6099-0335	75042	BTS, 33 Ω ±5%	
R23	Comp., 100 Ω ±5% 1/8 W	6098-1105	01121	BB, 100 Ω ±5%	
R24	Comp., 1.5 kΩ ±5% 1/8 W	6098-2155	01121	BB, 1.5 kΩ ±5%	
R25	Comp., 6.2 kΩ ±5% 1/4 W	6099-2625	75042	BTS, 6.2 kΩ ±5%	5905-682-4100

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R26	Comp., 100 Ω ±5% 1/8 W	6098-1105	01121	BB, 100 Ω ±5%	
R27	Comp., 1.1 kΩ ±5% 1/8 W	6098-2115	01121	BB, 1.1 kΩ ±5%	
R28	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R29	Cermet 200 Ω ±20%	6049-0312	24655	6049-0312	
R30	Comp., 2.4 kΩ ±5% 1/8 W	6098-2245	01121	BB, 2.4 kΩ ±5%	
R31	Comp., 620 Ω ±5% 1/4 W	6099-1625	75042	BTS, 620 Ω ±5%	5905-801-8272
R32	Comp., 33 Ω ±5% 1/4 W	6099-0335	75042	BTS, 33 Ω ±5%	
R33	Comp., 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R34 and R35	Comp., 15 Ω ±5% 1/4 W	6099-0115	75042	BTS, 15 Ω ±15%	
R36	Comp., 91 Ω ±5% 1/4 W	6099-0915	75042	BTS, 91 Ω ±5%	
R37	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R38	Comp., 15 Ω ±5% 1/4 W	6099-0115	75042	BTS, 15 Ω ±15%	
R39	Comp., 470 Ω ±5% 1/4 W	6099-1475	75042	BTS, 470 Ω ±5%	5905-683-2242
TRANSISTORS					
Q1	Type 2N5179	8210-1195	79089	2N5179	
Q2	Type 3N159	8210-1193	79089	3N159	
Q3	Type 2N5179	8210-1195	79089	2N5179	
Q4	Type 2N3906	8210-1112	04713	2N3906	
Q5 and Q6	Type 2N3903	8210-1132	04713	2N3903	



Etched-circuit diagram, Phase Modulator board — PC (P/N 1169-4008).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

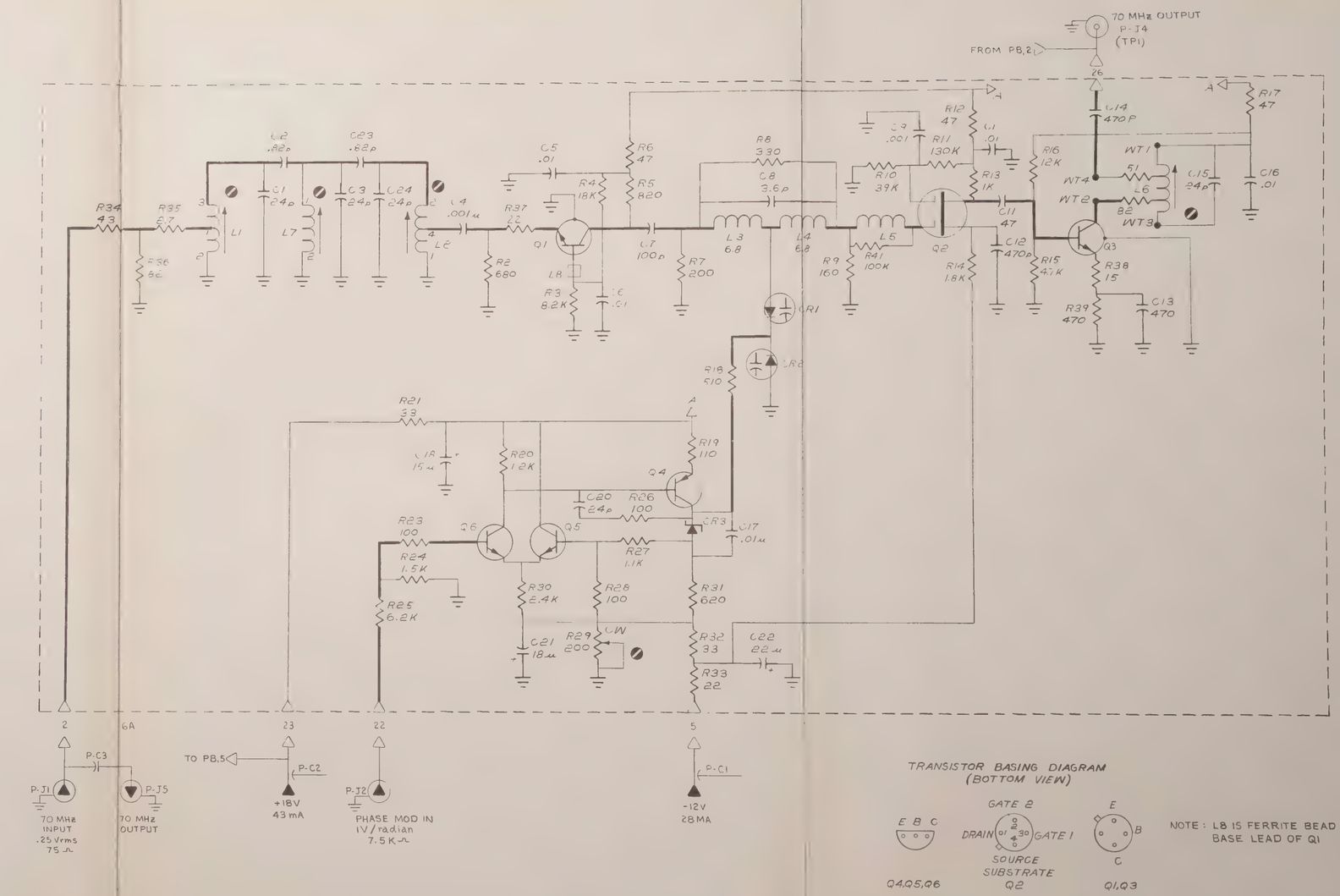
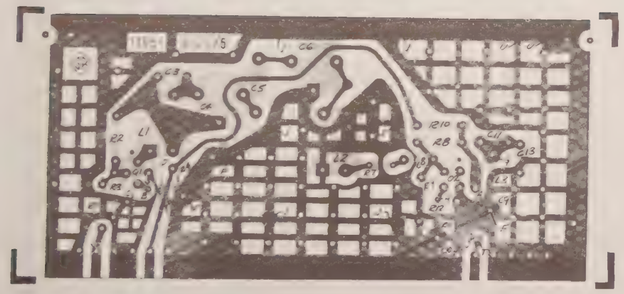


Figure 6-27. Phase modulator PC. (P/N 1169-4008)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1165-4022 420 MHz CIRCUIT ASM. (PB) (PM - 420)					
CAPACITORS					
C1	Ceramic, .001 µF +100-0 300 V	4400-5700	00656	BC-C1-2-NM	
C2	Ceramic, .001 µF +100-0 300 V	4400-5700	00656	BC-C1-2-NM	
C3	Ceramic, 3.0 pF N30 5% 500 V	4411-0035	72982	831, 3.0 pF N30 5%	
C4	Air Dielectric 1.4-9.2 pF 10%	4380-3800	74970	189-503-105	
C5	Ceramic, 0.47 pF 10% 500 V	4400-1200	78488	GA, .47 pF 10%	
C6	Air Dielectric, 1.4-9 pF 10%	4380-3800	74970	189-503-105	
C8	Ceramic, 22 pF 10% 500 V	4404-0228	72982	831, 22 pF 10%	
C9	Ceramic, .001 µF +100-0 300 V	4400-5700	00656	BC-C1-2-NM	
C10	Ceramic, .001 µF +100-0 300 V	4400-5700	00656	BC-C1-2-NM	
C11	Trimmer, 1.0-4.5 pF	4910-1102	73899	VC10GWV	
C12	Ceramic, 470 pF 5% 500 V	4404-1475	72982	831, 470 pF 5%	
C13	Ceramic, 3.0 pF N30 5% 500 V	4411-0035	72982	831, 3.0 pF N30	
RESISTORS					
R1	Comp., 4.7 Ω 5% 1/4 W	6099-9475	75042	BTS, 4.7 Ω 5%	
R2	Comp., 27 kΩ 5% 1/4 W	6099-3275	75042	BTS, 27 kΩ 5%	5905-683-3838
R3	Comp., 1 kΩ 5% 1/4 W	6099-2105	75042	BTS, 1 kΩ 5%	5905-681-6462
R4	Comp., 47 Ω 5% 1/4 W	6099-0475	75042	BTS, 47 Ω 5%	
R5	Comp., 10 Ω 5% 1/8 W	6098-0105	01121	BB, 10 Ω 5%	
R6	Comp., 180 Ω 5% 1/4 W	6099-1185	75042	BTS, 180 Ω 5%	5905-279-5476
R7	Comp., 15 Ω 5% 1/8 W	6098-0155	01121	BB, 15 Ω 5%	
R8	Comp., 30 kΩ 5% 1/4 W	6099-3305	75042	BTS, 30 kΩ 5%	5905-803-2908
R9	Comp., 3.9 kΩ 5% 1/4 W	6099-2395	75042	BTS, 3.9 kΩ 5%	
R10	Comp., 47 Ω 5% 1/4 W	6099-0475	75042	BTS, 47 Ω 5%	
R11	Comp., 220 Ω 5% 1/4 W	6099-1225	75042	BTS, 220 Ω 5%	5905-683-2240
R12	Comp., 10 Ω 5% 1/8 W	6098-0105	01121	BB, 10 Ω 5%	
TRANSISTORS					
Q1	Type 2N3478	8210-1111	12672	2N3478	
Q2	Type A485	8210-1194	73445	A485	
INDUCTORS					
L1	YE	1165-2215	24655	1165-2215	
L2	GN	1165-2225	24655	1165-2225	
L3	OR	1165-8185	24655	1165-8185	



Etched-circuit diagram, Phase Modulator Multiplier board — PB (P/N 1165-4022).

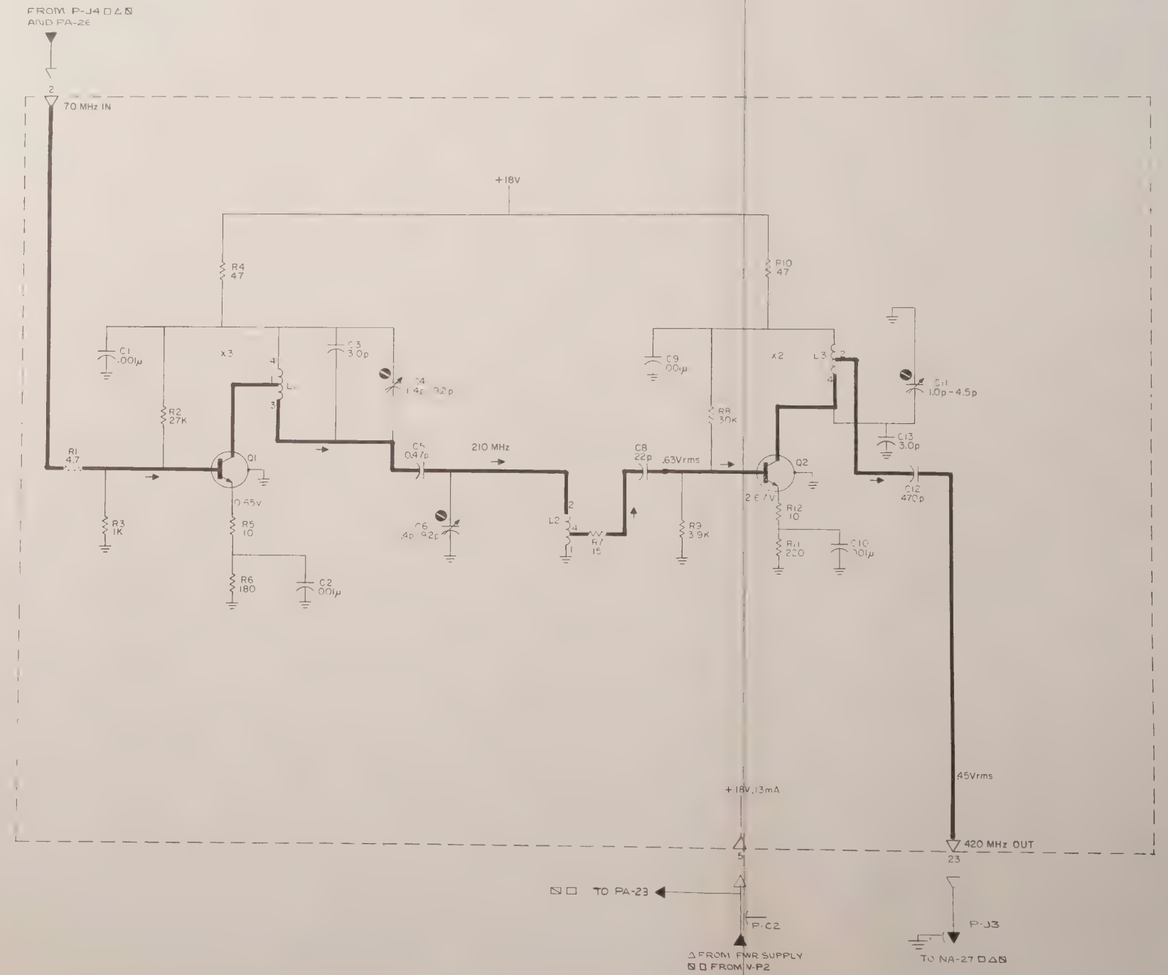
RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS, $\mu=10^{-6}$, $p=10^{-12}$
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
[ ] = PANEL CONTROL, < > = REAR CONTROL
⊘ = SCREWDRIVER CONTROL, WT = WIRE TIE, TP = TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER C-R1 B R1, ETC

4 0 4 F SWITCH NUMBERING
FRONT, REAR
CONTACTS, FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW

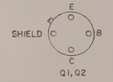
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF



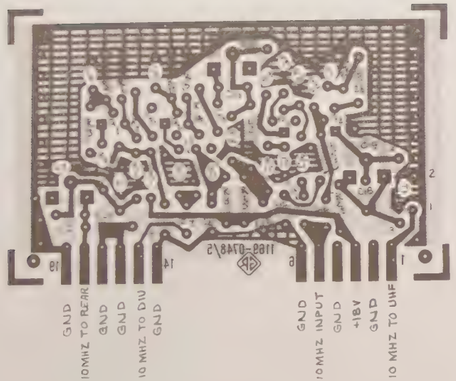
TRANSISTOR BASING (BOTTOM VIEW)



▨ = FOR 1065 APPLICATION
△ = FOR 1165 APPLICATION
□ = FOR 1168 APPLICATION

Figure 6-28. Phase modulator multiplier PB (P/N 1165-4022)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4048 REFERENCE BUFFER BOARD (RBA)					
CAPACITORS					
C1	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C2	Ceramic, 15 pF ±5% 500 V N030	4411-0155	80131	CC61, 15 pF ±5%	
C3	Trimmer Ceramic, 7-25 pF	4910-2032	72982	538-006, 7 to 25 pF	5910-998-1621
C4 thru					
C9	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C10	Ceramic, 20 pF ±5% 500 V N030	4411-0205	80131	CC61, 20 pF ±5%	
C11	Trimmer Ceramic, 7--25 pF	4910-2032	72982	538-006, 7 to 25 pF	5910-998-1621
C12 thru					
C17	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C18	Ceramic, 62 pF ±5% 100 V N030	4411-2002	09392	855, 62 pF ±5%	
C19	Trimmer Ceramic, 7-25 pF	4910-2032	72982	538-006, 7 to 25 pF	5910-998-1621
CHOKES					
L1	Molded, 8.2 µH ±10%	4300-2100	99800	1537-8.2 µH ±10%	5905-823-3168
L2	Molded, 6.8 µH ±10%	4300-1900	99800	1537-6.8 µH ±10%	
RESISTORS					
R1	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R2	Comp., 3.6 kΩ ±5% 1/4 W	6099-2365	75042	BTS, 3.6 kΩ ±5%	5905-577-0627
R3	Comp., 15 kΩ ±5% 1/4 W	6099-3155	75042	BTS, 15 kΩ ±5%	5905-681-8818
R4	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R5	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
R6	Comp., 180 Ω ±5% 1/4 W	6099-1185	75042	BTS, 180 Ω ±5%	5905-682-4107
R7 and					
R8	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R9	Comp., 110 Ω ±5%	6099-1115	75042	BTS, 110 Ω ±5%	
R10	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R11 and					
R12	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R13	Comp., 1.2 kΩ ±5% 1/4 W	6099-2125	75042	BTS, 1.2 kΩ ±5%	
R14	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R15	Comp., 620 Ω ±5% 1/4 W	6099-1625	75042	BTS, 620 Ω ±5%	5905-801-6998
R16	Comp., 3.3 kΩ ±5% 1/4 W	6099-2335	75042	BTS, 3.3 kΩ ±5%	5905-681-9969
R17	Comp., 15 kΩ ±5% 1/4 W	6099-3155	75042	BTS, 15 kΩ ±5%	5905-681-8818
R18	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R19	Comp., 3 kΩ ±5% 1/4 W	6099-2305	75042	BTS, 3 kΩ ±5%	5905-682-4097
R20	Comp., 390 Ω ±5% 1/4 W	6099-1395	75042	BTS, 390 Ω ±5%	
R21	Comp., 130 Ω ±5% 1/4 W	6099-1135	75042	BTS, 130 Ω ±5%	5905-807-0269
R22	Comp., 3 kΩ ±5% 1/4 W	6099-2305	75042	BTS, 3 kΩ ±5%	5905-682-4097
R23	Comp., 15 kΩ ±5% 1/4 W	6099-3155	75042	BTS, 15 kΩ ±5%	5905-681-8818
R26	Comp., 43 Ω ±5% 1/4 W	6099-0435	75042	BTS, 43 Ω ±5%	
R27	Comp., 180 Ω ±5% 1/4 W	6099-1185	75042	BTS, 180 Ω ±5%	5905-682-4107
R28	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
TRANSFORMERS					
T1	Wound	1165-2039	24655	1165-2039	
TRANSISTORS					
Q1	Type 2N3903	8210-1132	04713	2N3903	
Q2 and					
Q3	Type 2N5179	8210-1195	79089	2N5179	
Q4	Type 2N3903	8210-1132	04713	2N3903	



Etched-circuit diagram, Reference buffer board — RBA (P/N 1169-4048).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

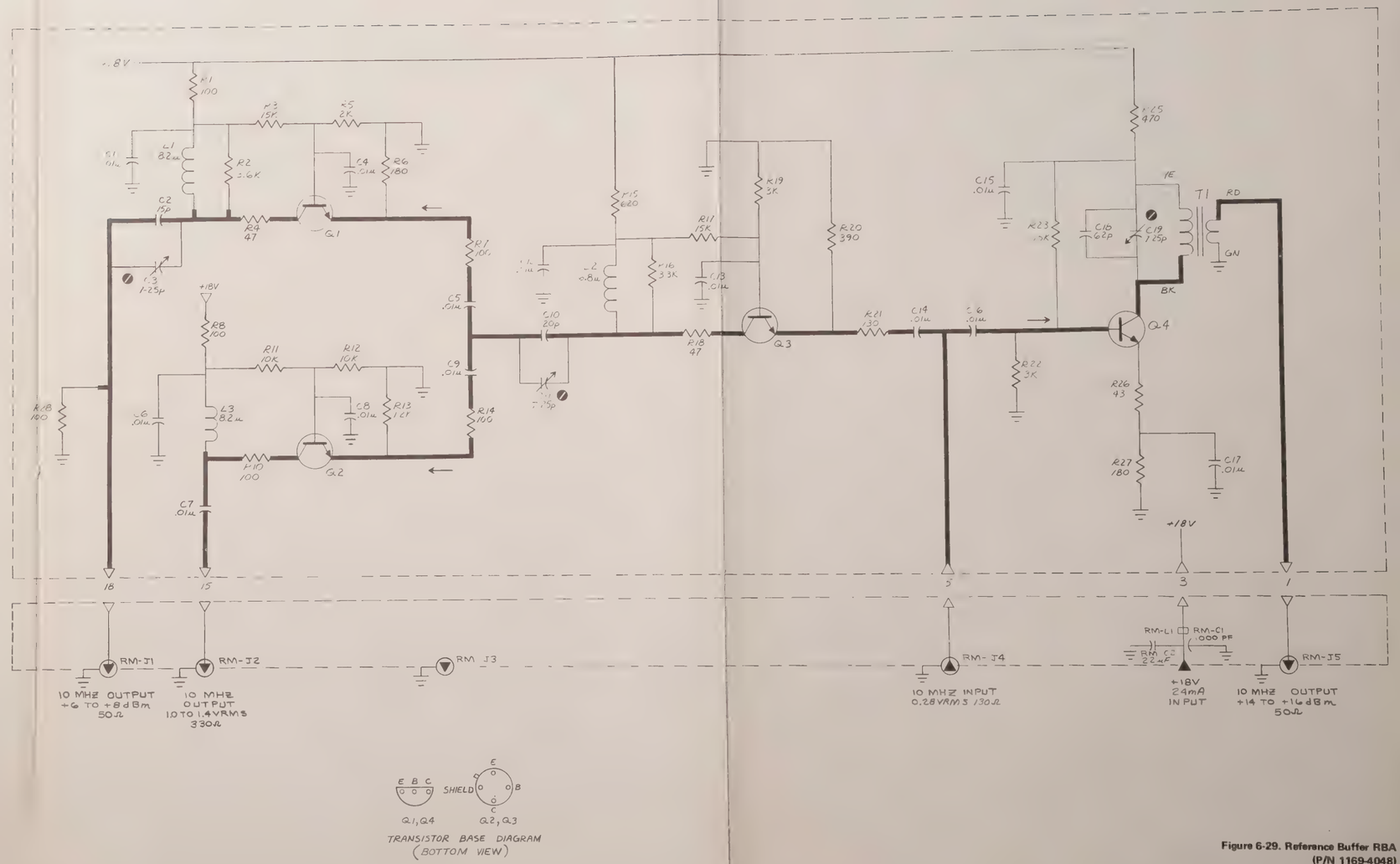
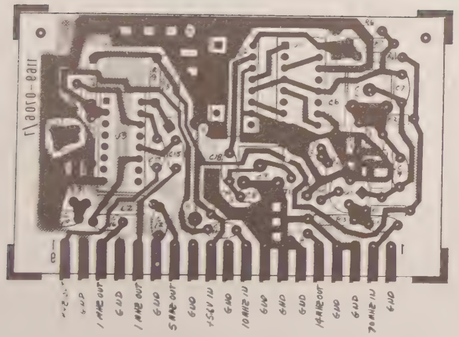


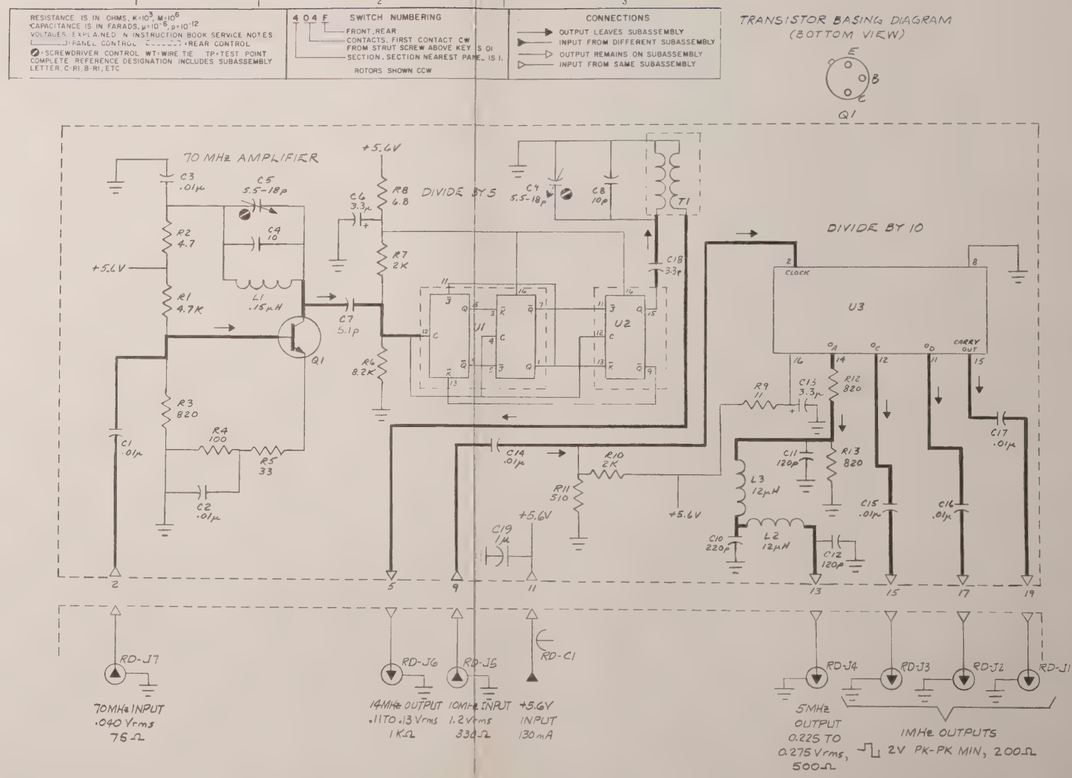
Figure 6-29. Reference Buffer RBA (P/N 1169-4048)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4006 REFERENCE DIVIDER BOARD (RDA)					
CAPACITORS					
C1 thru C3	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C4	Ceramic, 10 pF ±5% 500 V	4411-0105	72982	831, 10 pF ±5%	
C5	Trimmer, Ceramic 5.5-18 pF	4910-2031	72982	538-006, 5.5-18 pF	
C6	Tantalum, 3.3 µF ±20% 15 V	4450-4600	56289	150D335X0015A2	5910-837-9325
C7	Ceramic, 8.2 pF ±5% 500 V	4411-9825	80131	CC60, 8.2 pF ±5%	
C8	Ceramic, 10 pF ±5% 500 V	4411-0105	72982	831, 10 pF ±5%	
C9	Trimmer, Ceramic, 5.5-18 pF	4910-2031	72982	538-006, 5.5-18 pF	
C10	Ceramic, 220 pF ±10% 500 V	4404-1228	72982	831, 220 pF ±10%	
C11 and C12	Ceramic, 120 pF ±5% 500 V	4404-1125	72982	831, 120 pF ±5%	
C13	Tantalum, 3.3 µF ±20% 15 V	4450-4600	56289	150D335X0015A2	5910-837-9325
C14 thru C17	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C18	Ceramic, 5.1 pF ±5% 500 V	4411-9515	80131	CC60, 5.1 pF ±5%	
CHOKES					
L1	Molded, 0.15 µH ±10%	4300-0100	99800	1537-00	
L2 and L3	Molded, 12.0 µH ±10%	4300-2300	99800	1537-38 12 µH ±10%	5950-807-6050
INTEGRATED CIRCUITS					
U1 and U2	Type MC1032	5431-9620	04713	MC1032P	
U3	Type SN7416ON	5431-8060	96214	SN7416ON	
RESISTORS					
R1	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	75042	BTS, 4.7 kΩ ±5%	5905-686-9992
R2	Comp., 4.7 Ω ±5% 1/4 W	6099-9475	75042	BTS, 4.7 Ω ±5%	
R3	Comp., 820 Ω ±5% 1/4 W	6099-1825	75042	BTS, 820 Ω ±5%	
R4	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R5	Comp., 33 Ω ±5% 1/4 W	6099-0335	75042	BTS, 33 Ω ±5%	
R6	Comp., 8.2 kΩ ±5% 1/4 W	6099-2825	75042	BTS, 8.2 kΩ ±5%	
R7	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
R8	Comp., 6.8 Ω ±5% 1/4 W	6099-9685	75042	BTS, 6.8 Ω ±5%	
R9	Comp., 11 Ω ±5% 1/4 W	6099-0115	75042	BTS, 11 Ω ±5%	
R10	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
R11	Comp., 510 Ω ±5% 1/4 W	6099-1515	75042	BTS, 510 Ω ±5%	5905-801-8272
R12 and R13	Comp., 820 Ω ±5% 1/4 W	6099-1825	75042	BTS, 820 Ω ±5%	
TRANSISTORS					
Q1	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755
TRAY ASM					page 1
CAPACITORS					
C1		1165-8770	24655	1165-8770	
CONNECTORS					
J1 thru J7	RF Connector	1165-6020	24655	1165-6020	
SO1 and SO2	Contact Strip Asm	1165-1830	24655	1165-1830	
SO3	Contact Strip Asm	1165-1820	24655	1165-1820	



Etched-circuit diagram, Reference Divider board — RDA (P/N 1169-4006).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

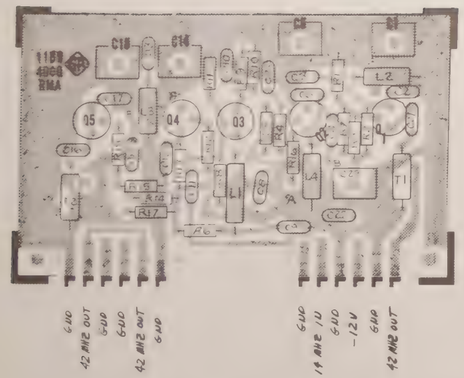


NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF

Figure 6-30. Reference Divider RDA. (P/N 1169-4006)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
TRAY ASM				
CAPACITORS				
C1		1165-8770	24655	1165-8770
CONNECTORS				
J1 thru J5	RF Insert	1165-6020	24655	1165-6020
SO1	Contact Strip Asm	1165-1820	24655	1165-1820
SO2	Contact Strip Asm	1165-1831	24655	1165-1831
RESISTORS				
R1	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%



Etched-circuit diagram, Reference Multiplier board — RMA (P/N 1169-4000).

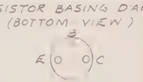
NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS; μ=10^{-6} p=10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
(——) PANEL CONTROL (- - - - -) REAR CONTROL
SCREWDRIVER CONTROL WT-WIRE TIE TP-TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER C R1 B R1 ETC

4 0 4 2 SWITCH NUMBERING
FRONT-REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW

CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

TRANSISTOR BASING DIAGRAM
(BOTTOM VIEW)



Q1 THRU Q5

COMPONENTS USED:
CAPACITORS - C1 THRU C13, C21, C22, C23
RESISTORS: R1 THRU R17, R19
INDUCTORS: L1 THRU L6
TRANSISTORS: Q1 THRU Q5
TRANSFORMERS: T1, T2

GND TERMINALS USED: 2, 4, 6, 14, 16, 17, 19

NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF

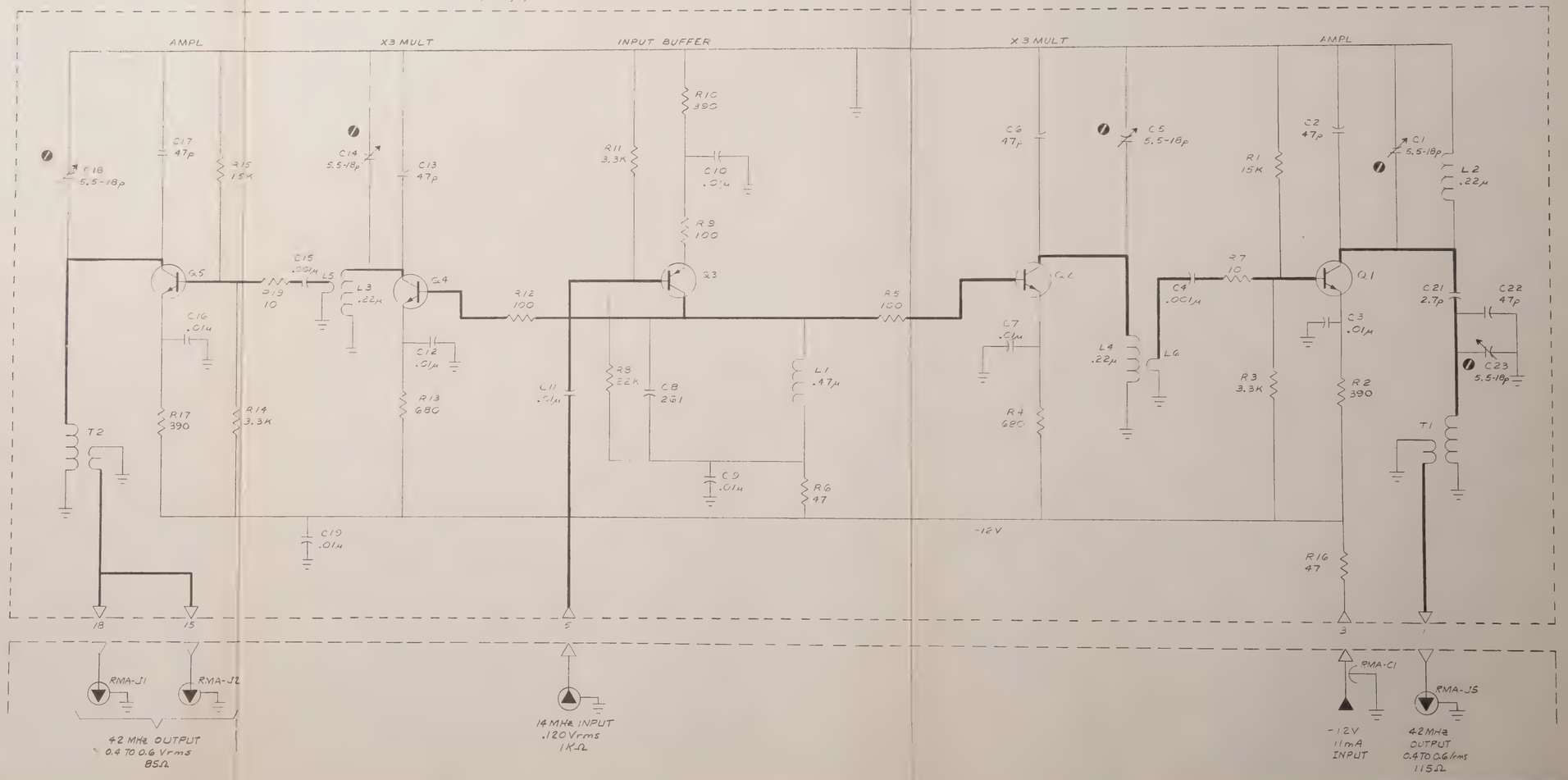
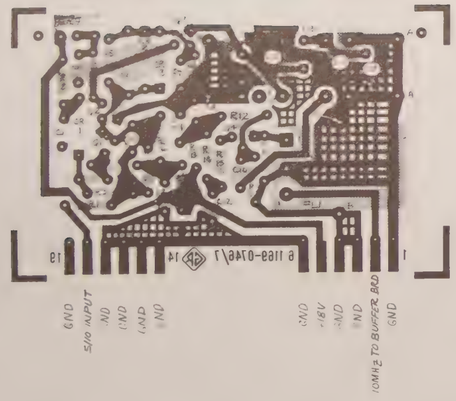


Figure 6-31. Reference Multiplier RMA (P/N 1169-4000)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4046 REFERENCE PROCESSOR BOARD (RPA)					
CAPACITORS					
C1 thru C4	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C5	Ceramic, 75 pF ±5% 500 V N030	4411-0753	72982	CC62, 75 pF ±5%	
C6 and C7	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C8 and C9	Mica, 270 pF ±1% 500 V	4710-0450	14655	22A, 270 pF ±1%	
C10 thru C12	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
CHOKES					
L1	Molded, 3.3 µH ±5%	4300-1402	99800	1537, .01 µF +80-20%	
DIODES					
CR1 thru CR3	Type 1N3604	6082-1001	24446	1N3604	
FILTERS					
FL1	Crystal, 10 MHz	5284-1000	82567	#F13138	
INDUCTORS					
L2 and L3	ASM (V1)	1169-2420	24655	1169-2420	
RESISTORS					
R1	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R2	Comp., 100 kΩ ±5% 1/4 W	6099-4105	75042	BTS, 100 kΩ ±5%	5905-686-3129
R3	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
R4	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R5	Comp., 2.2 kΩ ±5% 1/4 W	6099-2225	75042	BTS, 2.2 kΩ ±5%	5905-723-5251
R6 and R7	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2283
R8	Comp., 2.0 kΩ, ±5%, 1/4 W	6099-2205	75042	BTS, 2.0 kΩ, ±5%	
R9	Pot Cermet, 5 kΩ ±20%	6049-0316	24655	6049-0316	
R10	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R11 and R12	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2283
R13	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R14	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R15	Comp., 200 Ω ±5% 1/4 W	6099-1205	75042	BTS, 200 Ω ±5%	5905-683-2239
R16	Comp., 150 Ω ±5% 1/4 W	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
TRANSISTORS					
Q1 thru Q4	Type 2N3905	8210-1114	04713	2N3905	
CAPACITORS					
C1		1165-8770	24655	1165-8770	
CONNECTORS					
J1 and J2	RF Insert	1165-6020	24655	1165-6020	
SO1	Contact Strip Asm	1165-1812	24655	1165-1812	
SO2	Contact Strip Asm	1165-1820	24655	1165-1820	



Etched-circuit diagram, Reference Processor board (P/N 1169-4046).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

RESISTANCE IS IN OHMS. K=10^3, M=10^6
CAPACITANCE IS IN FARADS, $\mu=10^{-6}$, $p=10^{-12}$
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
FRONT PANEL CONTROL. REAR CONTROL.
SCREWDRIVER CONTROL. WT-WIRE TIE. TP-TEST POINT.
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER C R1 B R1 ETC

404F SWITCH NUMBERING
FRONT REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW

CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000pF

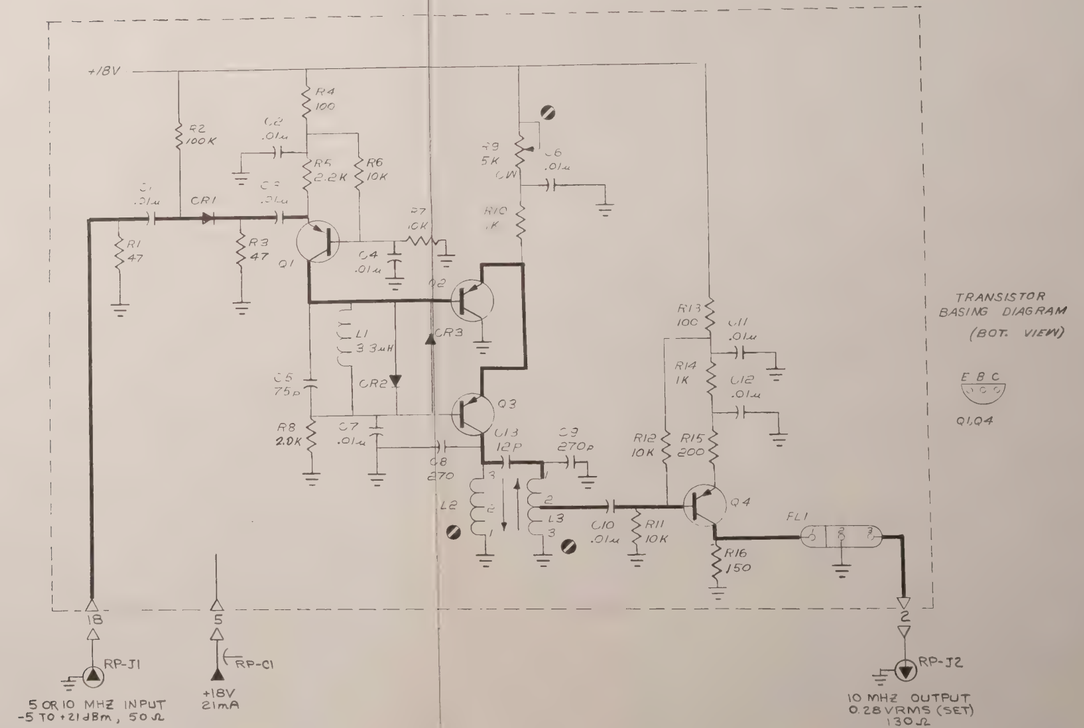
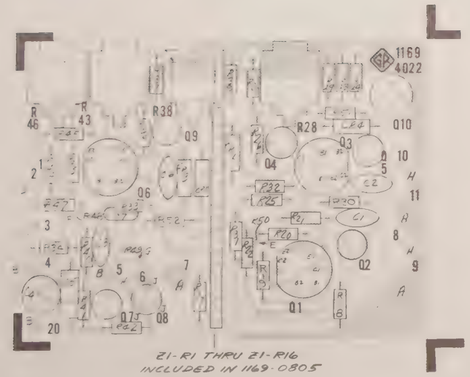


Figure 6-32. Reference Processor RPA. (P/N 1169-4046)

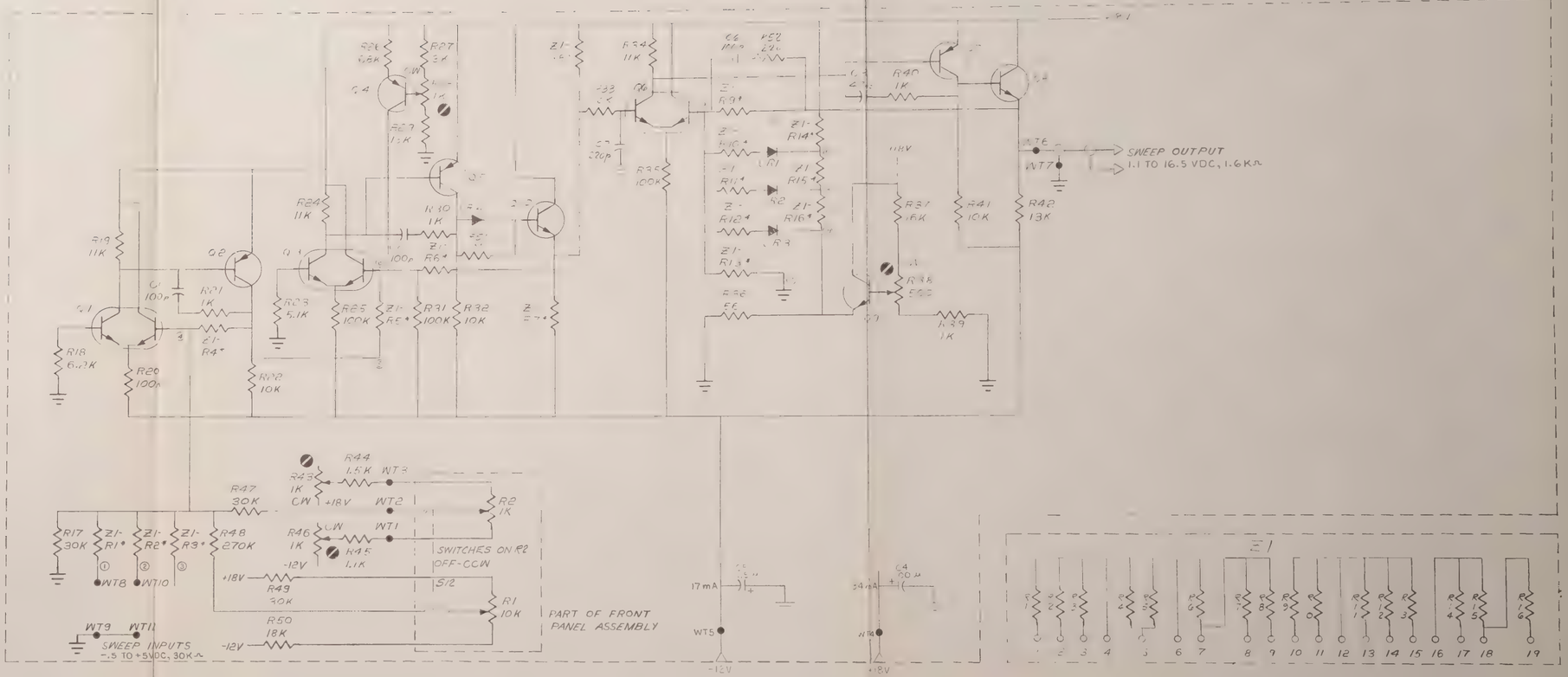
ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4022 SEARCH/SWEEP BOARD					
CAPACITORS					
C1 and C2	Ceramic, 100 pF ±10% 500 V	4404-1108	72982	831, 100 pF ±5%	
C3	Ceramic, 47 pF ±5% 500 V	4404-0475	72982	831, 47 pF ±5%	
C4	Tantalum, 100 µF ±20% 20 V	4450-6253	83740	C, 100 µF ±20%	
C5	Tantalum, 1.5 µF ±20% 20 V	4450-4400	56289	150D155Y0020A2	5910-670-7525
C6	Ceramic, 270 pF ±5% 500 V.	4404-1275	72982	831, 270 pF ±5%	
DIODES					
CR1 thru CR4	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
RESISTORS					
R17	Comp., 30 kΩ ±5% 1/4 W	6099-3305	75042	BTS, 30 kΩ ±5%	5905-803-2908
R18	Comp., 6.2 kΩ ±5% 1/4 W	6099-2625	75042	BTS, 6.2 kΩ ±5%	5905-682-4100
R19	Comp., 11 kΩ ±5% 1/4 W	6099-3115	75042	BTS, 11 kΩ ±5%	
R20	Comp., 100 kΩ ±5% 1/4 W	6099-4105	75042	BTS, 100 kΩ ±5%	5905-686-3129
R21	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R22	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R23	Comp., 5.1 kΩ ±5% 1/4 W	6099-2515	75042	BTS, 5.1 kΩ ±5%	5905-683-2241
R24	Comp., 11 kΩ ±5% 1/4 W	6099-3115	75042	BTS, 11 kΩ ±5%	
R25	Comp., 100 kΩ ±5% 1/4 W	6099-4105	75042	BTS, 100 kΩ ±5%	5905-686-3129
R26	Comp., 68 kΩ ±5% 1/4 W	6099-3685	75042	BTS, 68 kΩ ±5%	5905-681-8853
R27	Comp., 3 kΩ ±5% 1/4 W	6099-2305	75042	BTS, 3 kΩ ±5%	5905-682-4097
R28	Pot. Comp., 1 kΩ ±20% 25 W	6040-0400	01121	FWC, 1 kΩ ±20%	
R29	Comp., 15 kΩ ±5% 1/4 W	6099-3155	75042	BTS, 15 kΩ ±5%	5905-681-8818
R30	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R31	Comp., 100 kΩ ±5% 1/4 W	6099-4105	75042	BTS, 100 kΩ ±5%	5905.686-3129
R32 and R33	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R34	Comp., 11 kΩ ±5% 1/4 W	6099-3115	75042	BTS, 11 kΩ ±5%	
R35	Comp., 100 kΩ ±5% 1/4 W	6099-4105	75042	BTS, 100 kΩ ±5%	5905-686-3129
R36	Comp., 50 Ω ±5% 1/4 W	6099-0565	75042	BTS, 56 Ω ±5%	
R37	Comp., 16 kΩ ±5% 1/4 W	6099-3165	75042	BTS, 16 kΩ ±5%	
R38	Pot. Comp., 500 Ω ±20% 25 W	6040-0300	01121	FWC, 500 Ω ±20%	5905-072-7795
R39 and R40	Comp., 1 kΩ ±5% 1/4 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R41	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R42	Comp., 13 kΩ ±5% 1/4 W	6099-3135	75042	BTS, 13 kΩ ±5%	5905-702-4439
R43	Pot. Comp., 1 kΩ ±20% 25 W	6040-0400	01121	FWC, 1 kΩ ±20%	
R44	Comp., 1.5 kΩ ±5% 1/4 W	6099-2155	75042	BTS, 1.5 kΩ ±5%	
R45	Comp., 1.1 kΩ ±5% 1/4 W	6099-2115	75042	BTS, 1.1 kΩ ±5%	
R46	Pot. Comp., 1 kΩ ±20% 25 W	6040-0400	01121	FWC, 1 kΩ ±20%	
R47	Comp., 30 kΩ ±5% 1/4 W	6099-3305	75042	BTS, 30 kΩ ±5%	5905-803-2908
R48	Comp., 270 kΩ ±5% 1/4 W	6099-4275	75042	BTS, 270 kΩ ±5%	
R49	Comp., 30 kΩ ±5% 1/4 W	6099-3305	75042	BTS, 30 kΩ ±5%	5905-803-2908
R50	Comp., 18 kΩ ±5% 1/4 W	6099-3185	75042	BTS, 18 kΩ ±5%	5905-687-0000
R51	Comp., 1 MΩ ±5% 1/4 W	6099-5105	75042	BTS, 1 MΩ ±5%	
R52	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
Z1	Network, Thin Film	1169-0805	24655	1169-0805	
TRANSISTORS					
Q1	Type TD-100	8210-1130	56289	TD-100	
Q2	Type 2N4250	8210-1135	07263	2N4250	
Q3	Type TD-100	8210-1130	56289	TD-100	
Q4	Type 2N3905	8210-1114	04713	2N3905	
Q5	Type 2N4250	8210-1135	07263	2N4250	
Q6	Type TD-100	8210-1130	56289	TD-100	
Q7	Type 2N4250	8210-1135	07263	2N4250	
Q8	Type 2N3903	8210-1132	04713	2N3903	
Q9	Type 2N3391A	8210-1092	24454	2N3391A	
Q10	Type 2N3903	8210-1132	04713	2N3903	



Etched-circuit diagram, Search/Sweep Driver board — SSA (P/N 1169-4022).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

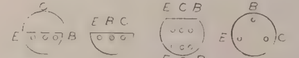


COMPONENTS USED:

CAPACITORS: C1-C7
RESISTOR NETWORK: Z1
RESISTORS: R1 THRU R52
DIODES: CR1 THRU CR4
TRANSISTORS: Q1 THRU Q10

NOTE: ⓝ TERMINAL NUMBERS ON RESISTOR NETWORK
Z1 R * RESISTORS ON THIN FILM NETWORK (1169-0805)

TRANSISTOR BASE DIAGRAMS



Q9 Q4,Q8,Q10 Q1,Q3,Q6 Q2,Q5,Q7

Figure 6-33. Search/sweep driver — SSA. (P/N 1169-4022)

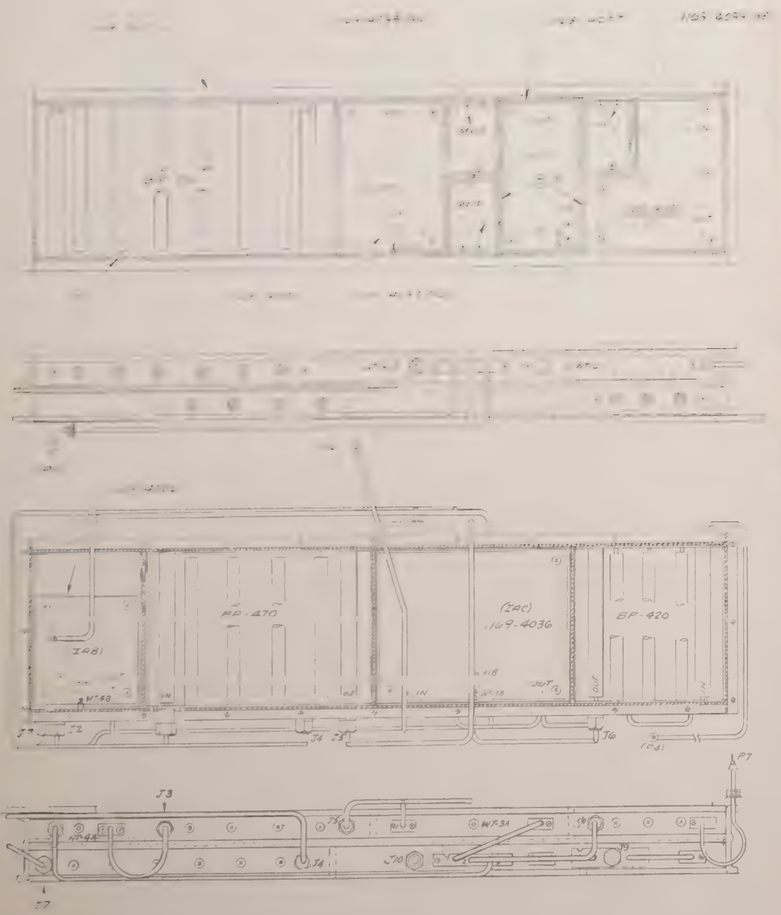
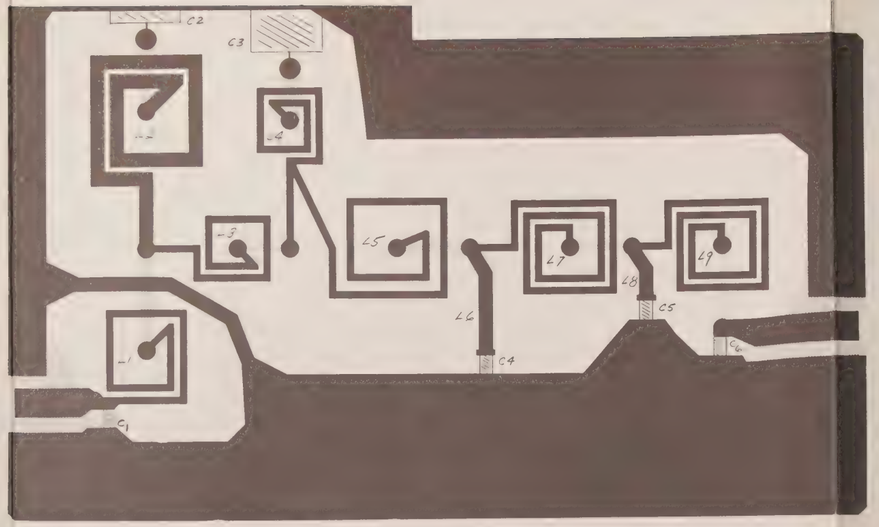
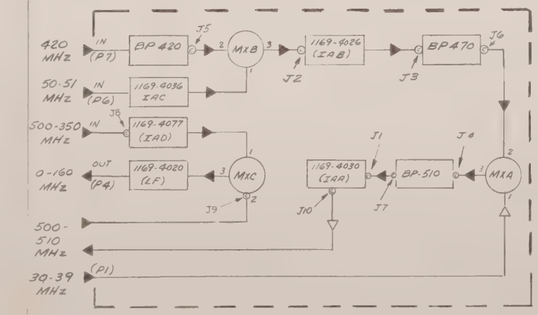


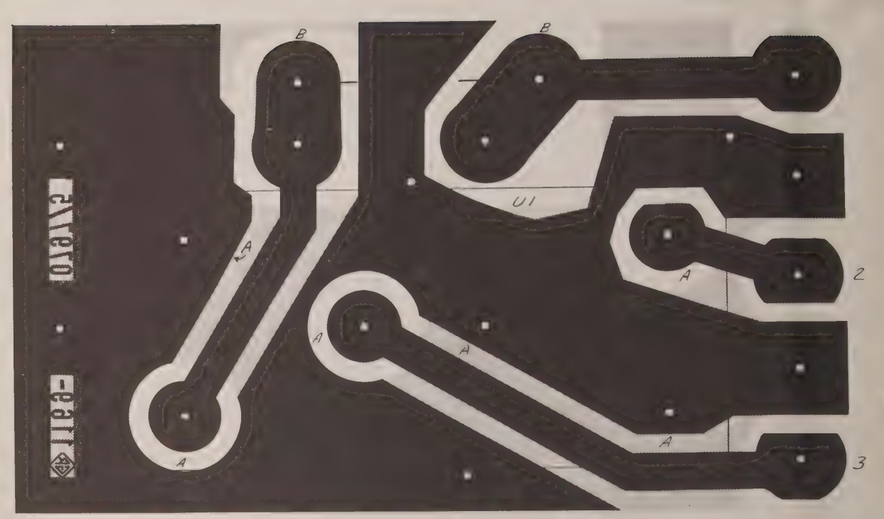
Figure 6-34. UHF Section assembly.



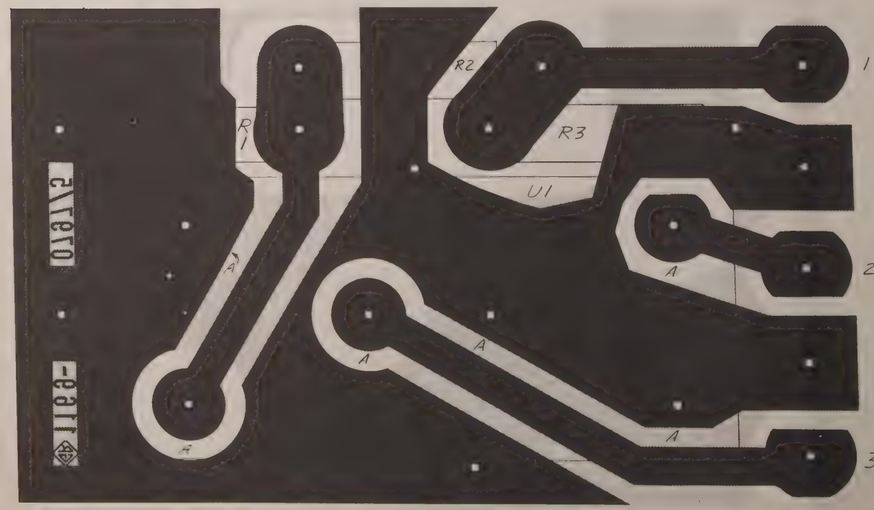
Etched-circuit diagram, Low-Pass Filter board — LPA (P/N 1169-4020).



NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



Etched-circuit diagram, Mixer board — MXA (P/N 1169-4097).



Etched-circuit diagram, Mixer boards — MXB (P/N 1169-4098)/ MXC (P/N 1169-4099)

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4097 MIXER BOARD ASM MXB (500 MHz OUTPUT)					
INTEGRATED CIRCUITS					
U1	Mixer, Type M6F	5434-0100	23367	M6F	

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4098 MIXER BOARD ASM MXA (470 MHz OUTPUT)					
CONNECTORS					
	Signal Jack	4260-1830	00528	#170TMT-025-1	
INTEGRATED CIRCUIT					
U1	Mixer, Type M6F	5434-0100	23367	M6F	
RESISTORS					
R1	Comp., 430 Ω ±5% 1/4 W	6099-1435	75042	BTS, 430 Ω ±5%	
R2	Comp., 12 Ω ±5% 1/4 W	6099-0125	75042	BTS, 12 Ω ±5%	5905-806-0633
R3	Comp., 430 Ω ±5% 1/4 W	6099-1435	75042	BTS, 430 Ω ±5%	

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4099 MIXER BOARD ASM MXC (160 MHz OUTPUT)					
CONNECTORS					
	Signal Jack	4260-1830	00528	#170TMT-025-1	
INTEGRATED CIRCUITS					
U1	Mixer, Type M6F	5434-0111	23367	M6F	
RESISTORS					
R1	Comp., 150 Ω ±5% 1/4 W	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
R2	Comp., 36 Ω ±5% 1/4 W	6099-0365	75042	BTS, 36 Ω ±5%	
R3	Comp., 150 Ω ±5% 1/4 W	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4020 LOW PASS FILTER BD. LPA					
CAPACITORS					
C1	Ceramic, Chip, 25 pF ±2% 50 V	4399-0145	00544	25 pF ±2%	
C2	Ceramic, 15 pF ±1% 500 V	4400-3301	72982	315N750, 15 pF ±1%	
C3	Ceramic, 22.1 pF ±1% 500 V	4400-3601	00656	NP0K, 22 pF ±10%	
C4	Ceramic Chip, 38 pF ±2% 50 V	4399-0146	00544	38 pF ±2%	
C5	Ceramic Chip, 40 pF ±2% 50 V	4399-0147	00544	40 pF ±2%	
C6	Ceramic Chip, 25 pF ±2% 50 V	4399-0145	00544	25 pF ±2%	

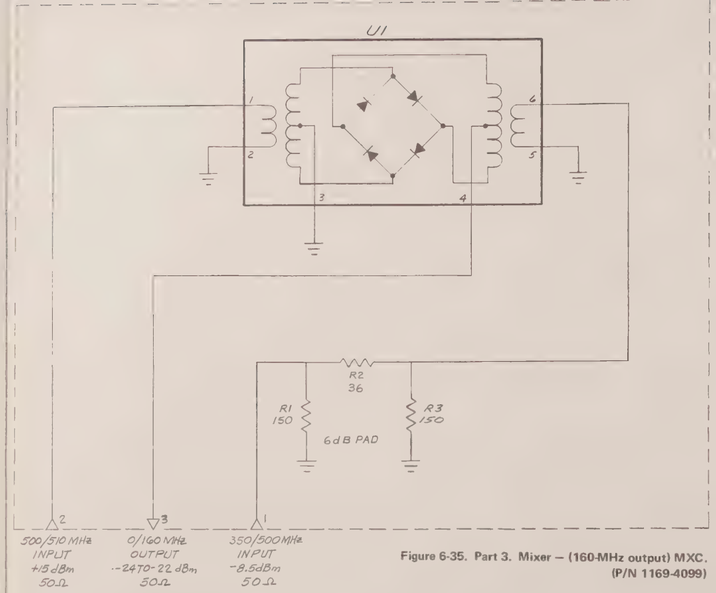


Figure 6-35. Part 3. Mixer — (160-MHz output) MXC. (P/N 1169-4099)

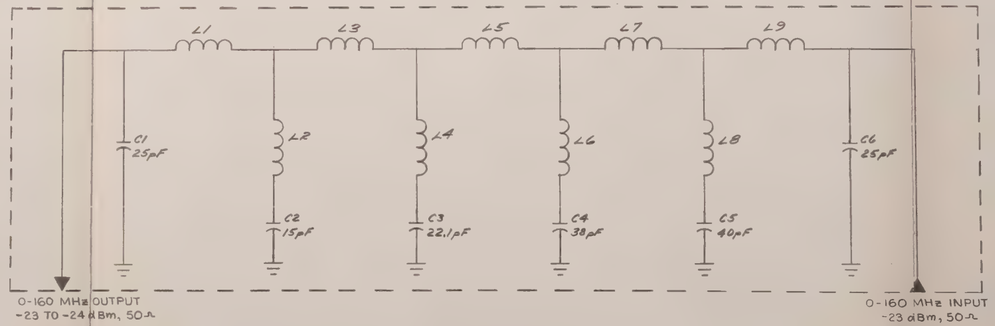


Figure 6-35. Part 4. Low-pass Filter — LPA. (P/N 1169-4020)

ROTARY SWITCH NUMBERING
WAFER SURFACE FRONT, REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01.
SECTION: SECTION NEAREST PANEL IS 1
ROTORS SHOWN CCW
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

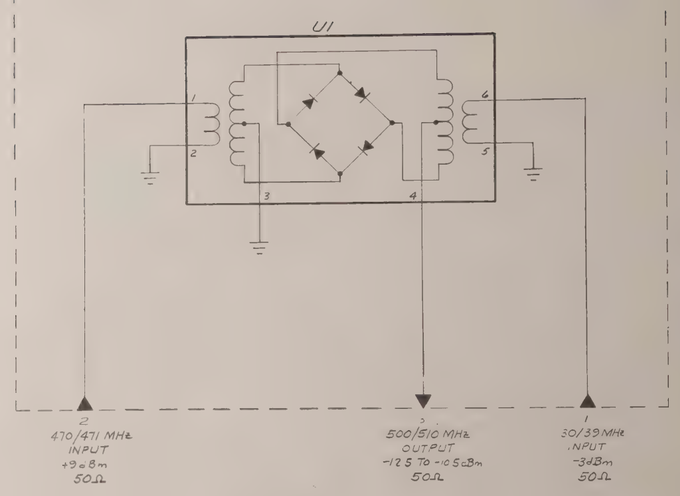


Figure 6-35. Part 1. Mixer — (510 MHz output) MXA. (P/N 1169-4097)

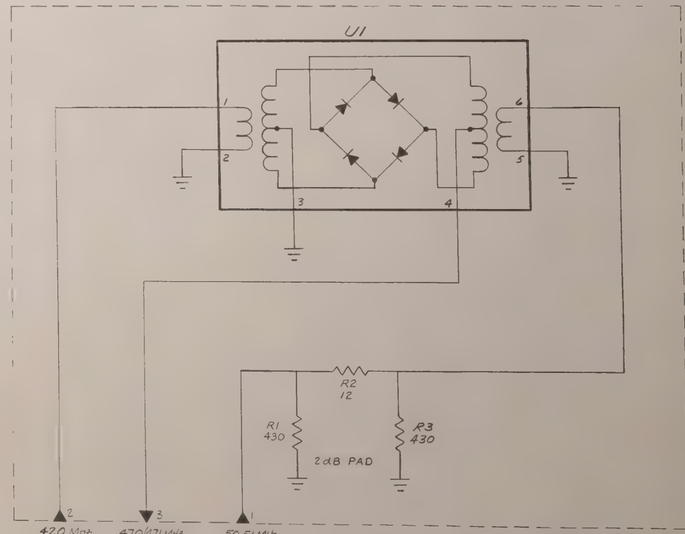


Figure 6-35. Part 2. Mixer — (470-MHz output) MXB. (P/N 1169-4098)

ELECTRICAL PARTS LIST

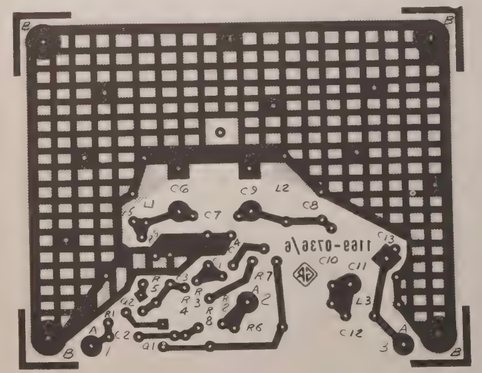
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
[illegible]-4120 UHF ASSEMBLY					
[illegible]CTORS					
[illegible]	[illegible], 1500 pF 200 V 10 A	1452-1101	24655	1452-1101	
[illegible]-4030 INTERMEDIATE AMPLIFIER BOARD (IAA)					
CAPACITORS					
C1	Ceramic, 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C2 and					
C3	Ceramic, 1000 pF ±10% 500 V	4404-2108	72982	801, 1000 pF ±10%	
C4	Ceramic, 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C5 and					
C6	Ceramic, 1000 pF ±10% 500 V	4404-2108	72982	801, 1000 pF ±10%	
C7	Ceramic, 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C8	Ceramic, 1000 pF ±10% 500 V	4404-2108	72982	801, 1000 pF ±10%	
C9	Ceramic, .001 µF +100-0% 300 V	4400-5700	00656	BC-C1-2-NM	
C10	Ceramic, 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C11	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C12	Ceramic, 3.0 pF ±5% N30	4411-0035	80131	CC60, 3.0 pF ±5%	
[illegible]					
C14	Trimmer, 3.5-13 pF	4910-2071	72982	TS-TR1K0-02	
INDUCTORS					
L1 and L2		1160-6030	24655	1169-6030	
RESISTORS					
R1	Comp., 3.9 kΩ ±5% .25 W	6099-2395	75042	BTS, 3.9 kΩ ±5%	
R2	Comp., 8.2 kΩ ±5% .25 W	6099-2825	75042	BTS, 8.2 kΩ ±5%	
R3	Comp., 1 kΩ ±5% .25 W	6099-2105	75042	BTS, 1 kΩ ±5%	5905-681-6422
R4	Comp., 22 Ω ±5% .25 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R5	Comp., 8.2 kΩ ±5% .25 W	6099-2825	75042	BTS, 8.2 kΩ ±5%	
R6	Comp., 3.9 kΩ ±5% .25 W	6099-2395	75042	BTS, 3.9 kΩ ±5%	
R7	Pot, Comp., 2.5 kΩ ±20% .25 W	6040-0500	01121	FWC, 2.5 kΩ ±20%	5905-931-6868
R8	Comp., 1.8 kΩ ±5% .25 W	6099-2185	75042	BTS, 1.8 kΩ ±5%	5905-688-3738
R9	Comp., 47 Ω ±5% .25 W	6099-0475	75042	BTS, 47 Ω ±5%	
R10	Comp., 22 Ω ±5% .25 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-755-8389
R11 and R14	Comp., 270 Ω ±5% .25 W	6099-1275	75042	BTS, 270 Ω ±5%	
R15	Comp., 100 Ω ±5% .25 W	6099-1105	75042	BTS, 100 Ω ±5%	
R16 and R17					
R18	Comp., 10 Ω ±5% .12 W	6098-0105	01121	BB, 10 Ω ±5%	
R19	Comp., 10 Ω ±5% .25 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
TRANSISTORS					
Q1	Type 2N5179	8210-1195	79089	2N5179	
Q2	Type A485	8210-1194	03715	A485	
Q3	Type 5109	8210-1198	79089	5109	

ELECTRICAL PARTS LIST

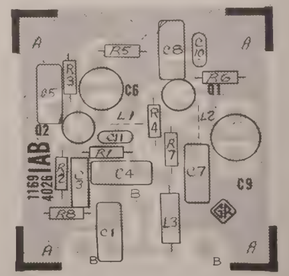
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4026 INTERMEDIATE AMPLIFIER BD. IAB					
CAPACITORS					
C1	Mica, 220 pF ±5% 500 V	4700-0519	14655	22A, 220 pF ±5%	
C3	Mica, 16 pF ±5% 500 V	4700-0210	14655	22A5Q16JC	
C4 and C5	Mica, 220 pF ±5% 500 V	4700-0519	14655	22A, 220 pF ±5%	
C6	Trimmer Ceramic, 2.8 pF	4910-2045	72982	538-002, 2 to 8 pF	
C7 and C8	Mica, 220 pF ±5% 500 V	4700-0519	14655	22A, 220 pF ±5%	
C9	Trimmer Ceramic, 2.8 pF	4910-2045	72982	538-002, 2 to 8 pF	
C10 and C11	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .0 µF +80-20%	5910-974-5697
INDUCTORS					
L1		1169-8430	24655	1169-8430	
L2		1169-8450	24655	1169-8450	
L3	Molded, 0.1 µH ±10%	4300-7555	72259	1025	
RESISTORS					
R1	Comp., 12 kΩ ±5% 1/4 W	6099-3125	75042	BTS, 12 kΩ ±5%	
R2	Comp., 2.2 kΩ ±5% 1/4 W	6099-2225	75042	BTS, 2.2 kΩ ±5%	5905-723-5251
R3	Comp., 240 Ω ±5% 1/4 W	6099-1245	75042	BTS, 240 Ω ±5%	
R4	Comp., 12 kΩ ±5% 1/4 W	6099-3125	75042	BTS, 12 kΩ ±5%	
R5	Comp., 2.2 kΩ ±5% 1/4 W	6099-2225	75042	BTS, 2.2 kΩ ±5%	5905-723-5251
R6	Comp., 240 Ω ±5% 1/4 W	6099-1245	75042	BTS, 240 Ω ±5%	
R7	Comp., 2.7 Ω ±5% 1/4 W	6099-9275	75042	BTS, 2.7 Ω ±5%	
R8	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
TRANSISTORS					
Q1 and Q2	Type 2N5179	8210-1195	79089	2N5179	
1169-4036 INTERMEDIATE AMPLIFIER BD IAC					
CAPACITORS					
C1 thru C4	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C5	Mica, 51 pF ±5% 500 V	4700-0354	88419	22A5Q51	
C6	Trimmer Ceramic, 7-25 pF	4910-2043	72982	538-002, 7-25 pF	
C7	Tubular, 2.2 pF ±5% 500 V	4400-0205	78488	GA, 2.2 pF	5910-667-6114
C8	Mica, 51 pF ±5% 500 V	4700-0354	88419	22A5Q51	
C9	Trimmer Ceramic, 7-25 pF	4910-2043	72982	538-002, 7-25 pF	
C10	Tubular, 1.5 pF ±5% 500 V	4400-0150	78488	GA, 1.5 pF ±5%	
C11	Trimmer Ceramic, 7-25 pF	4910-2043	72982	538-002, 7-25 pF	
C12	Mica, 62 pF ±5% 500 V	4700-0364	14655	22A, 62 pF ±5%	
C13	Mica, 270 pF ±1% 500 V	4710-0450	14655	22A, 270 pF ±1%	
RESISTORS					
R1	Comp., 51 Ω ±5% 1/4 W	6099-0515	75042	BTS, 51 Ω ±5%	
R2	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
R3	Comp., 3.3 kΩ ±5% 1/4 W	6099-2335	75042	BTS, 3.3 kΩ ±5%	5905-681-9969
R4	Comp., 3.9 kΩ ±5% 1/4 W	6099-2395	75042	BTS, 3.9 kΩ ±5%	
R5	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R6	Comp., 300 Ω ±5% 1/4 W	6099-1305	75042	BTS, 300 Ω ±5%	5905-279-5481
R7	Pot Cermet, 100 Ω ±10%	6049-0212	01121	SV1011	
R8	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R9	Comp., 47 Ω ±5% 1/4 W	6099-0475	75042	BTS, 47 Ω ±5%	
TRANSISTORS					
Q1	Type 2N4258	8210-1136	07263	2N4258	
Q2	Type 2N3905	8210-1114	04713	2N3905	

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4077 ISOLATION AMPLIFIER BOARD (IAD)					
CAPACITORS					
C1	Trimmer Ceramic, 3.5-13 pF	4910-2071	72982	TS-TR1K0-02	
C2	Ceramic, 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C3	Ceramic, 5.1 pF ±5% 500 V	4411-9515	80131	CC60, 5.1 pF ±5%	
C4 and C5	Ceramic, 1000 pF +80-20% 500 V	4404-2109	72982	831, 100 pF ±5%	5910-075-9607
C6	Ceramic, 3.3 pF ±5% 500 V	4411-9335	80131	CC60, 3.3 pF ±5%	
CHOKES					
L1		1169-8620	24655	1169-8620	
L2	Molded, 0.15 µH ±10%	4300-0101	99800	1536	
RESISTORS					
R1	Comp., 91 Ω ±5% 1/4 W	6099-0915	75042	BTS, 91 Ω ±5%	
R2	Comp., 68 Ω ±5% 1/4 W	6099-0685	75042	BTS, 68 Ω ±5%	
R3	Comp., 91 Ω ±5% 1/4 W	6099-0915	75042	BTS, 91 Ω ±5%	
R4 and R5	Comp., 6.8 kΩ ±5% 1/4 W	6099-2685	75042	BTS, 6.8 kΩ ±5%	5905-686-9997
R6	Comp., 1.2 kΩ ±5% 1/4 W	6099-2125	75042	BTS, 1.2 kΩ ±5%	
R7	Comp., 36 Ω ±5% 1/4 W	6099-0365	75042	BTS, 36 Ω ±5%	
R8	Comp., 150 Ω ±5% 1/4 W	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
R9	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R10	Comp., 51 Ω ±5% 1/4 W	6099-0515	75042	BTS, 51 Ω ±5%	
R11	Comp., 150 Ω ±5% 1/4 W	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
TRANSISTORS					
Q1	Type 2N5179	8210-1195	79089	2N5179	



Etched-circuit diagram, Amplifier board — IAC (P/N 1169-4036)



Etched-circuit diagram, Amplifier board — IAB (P/N 1169-4026)

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

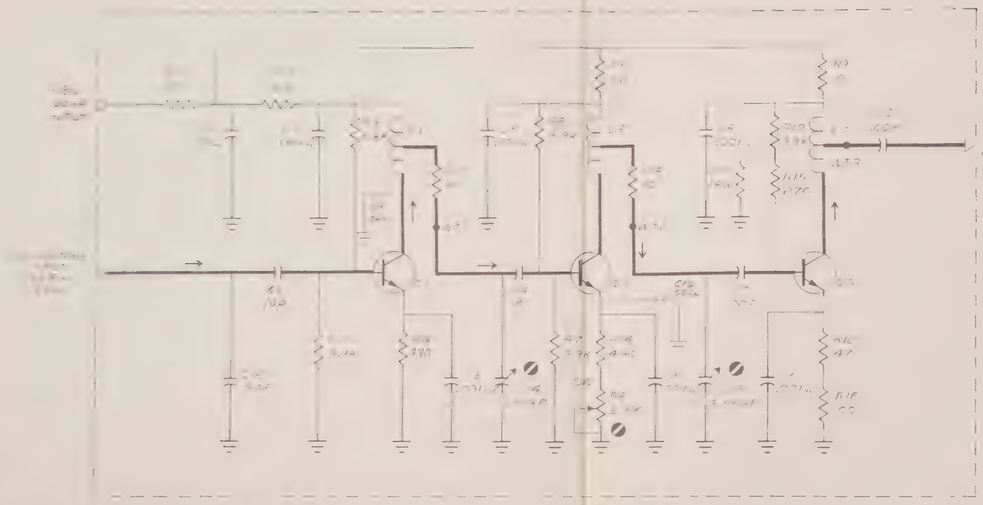
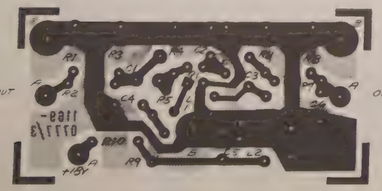


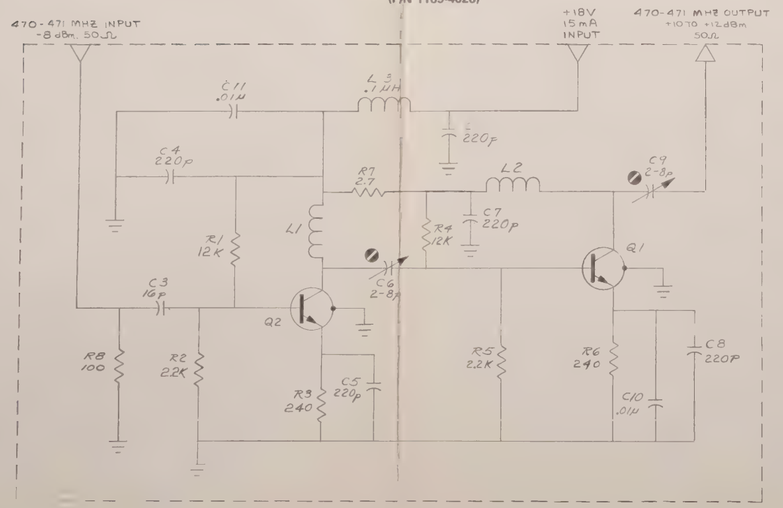
Figure 6-36. Part 1. 500–510 MHz Amplifier IAA.
(P/N 1169-4030)

Etched-circuit diagram, Intermediate Amplified board – IAA (P/N 1169-4030).



Etched-circuit diagram, Intermediate Amplifier board – IAD (P/N 1169-4077).

Figure 6-36. Part 2. 470-MHz Amplifier IAB.
(P/N 1169-4026)



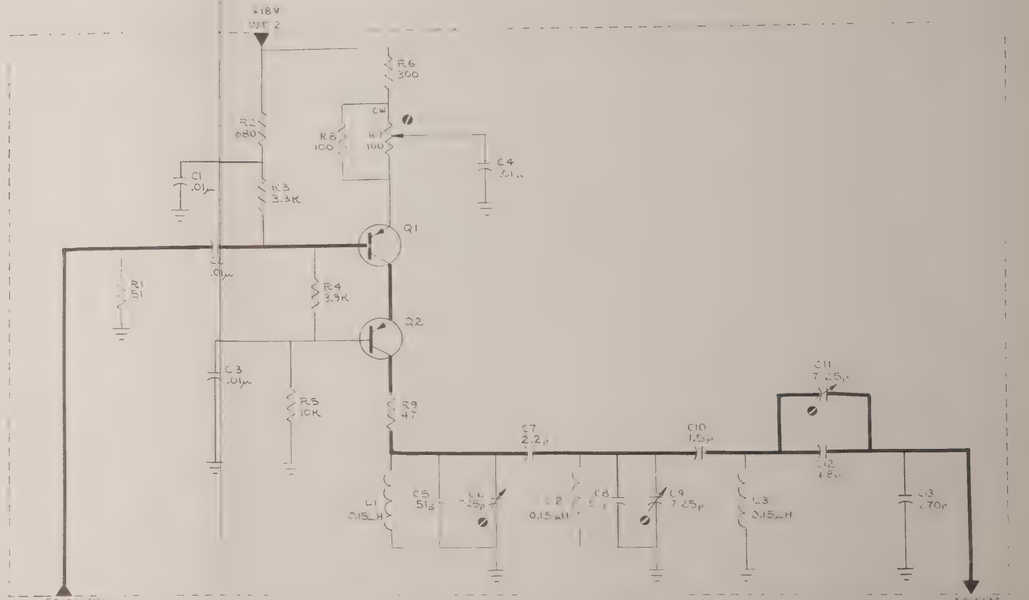


Figure 6-37. Part 1. 50-MHz Amplifier IAC.
(P/N 1169-4036)

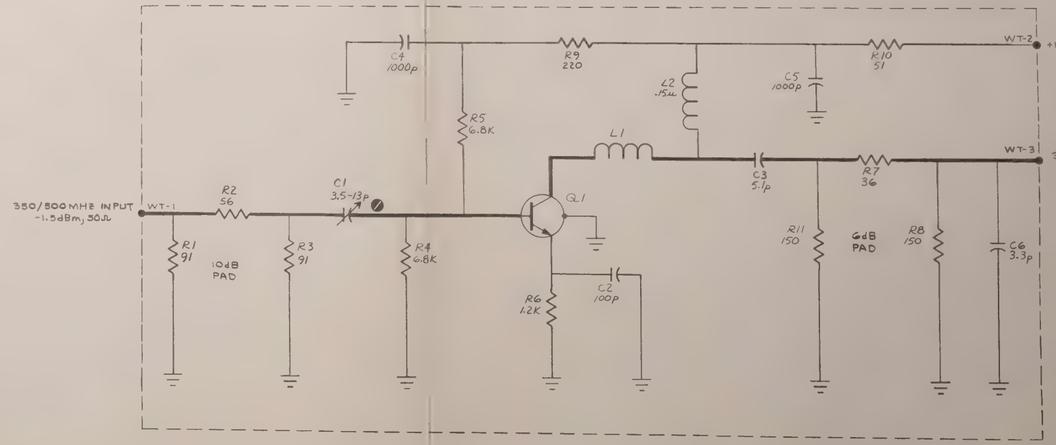


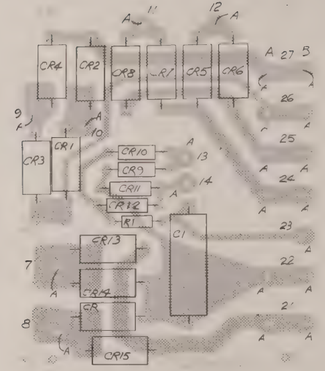
Figure 6-37. Part 2. 350–500 MHz Amplifier IAD.
(P/N 1169-4077)

ELECTRICAL PARTS LIST

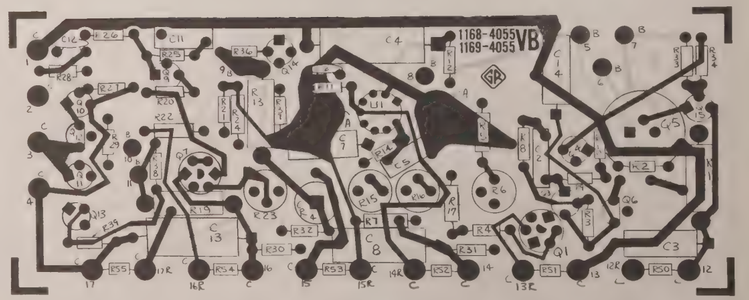
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
	[illegible]				
	[illegible]				
	[illegible], 7500 µF +75-10% 20 V	4450-6222	80183	32D722G0115BA6B	
	[illegible], 4500 µF +75-10% 40 V	4450-6221	56289	32342G030BA6B	
	[illegible], 3400 µF +75-10% 40 V	4450-4100	56289	32D	
4	Mylar, 2.2 µF ±10% 50 V	4860-9853	84411	663UW, 2.2 µF ±10%	
	[illegible]				
	[illegible], Power, C.E.E. Std.	4240-0210	05051	4240-0210	
	[illegible] Types DR	4230-5220	95354	81-6020-1100	
J1 thru J5	Connector, Jack	4260-1010	91916	SKT-8	
F1	FUSES				
	Slo-Blo 1/2 A	5330-1000	71400	MdL, .5 Amp	5920-199-9498
	Slo-Blo 1A	5330-1400	71400	MdL, 1 Amp	5920-852-6322
	RESISTORS				
R1 thru R3	Comp., 300 Ω ±5% 1/4 W	6099-1305	75042	BTS, 300 Ω ±5%	5905-279-5481
R4	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R5	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
	SWITCHES				
S1	Line Voltage	7890-1382	76854	82227-H7C	
	TRANSISTORS				
Q1 thru Q3	Type 40250	8210-1095	79089	40250	
Q4	Type 2N3055	8210-1097	56232	2N3055	
	TRANSFORMERS				
T1	Transformer	0365-4022	24655	0365-4022	
	REGULATOR BOARD VB (P/N 1169-4055)				
	CAPACITORS				
C2	Ceramic, 0.1 µF ±20% 50 V	4400-2050	80183	5C13, .1 µF ±20%	5910-080-4646
C3	Tantalum, 47 µF ±20% 6 V	4450-5500	56289	150D476X0006B2	5910-752-4185
C4	Tantalum, 150 µF ±20% 15 V	4450-5705	56289	150D107X0020S3	
C5	Ceramic, 1 µF ±20% 50 V	4400-2070	80183	5C13, 1 µF ±20%	5910-083-6445
C6	Ceramic, 1000 pF ±20% 500 V	4404-2100	72982	831, 1000 pF ±20%	
C7	Tantalum, 6.8 µF ±2% 35 V	4450-5000	56289	150D685X0035B2	5910-814-5869
C8	Tantalum, 47 µF ±20% 20 V	4450-5614	56289	150D4760020R2	
C11	Ceramic, 0.1 µF ±20% 50 V	4400-2050	80183	5C13, 1 µF ±20%	5910-080-4646
C12	Ceramic, .01 µF +80-20% 100 V	4401-3100	80131	CC61, .01 µF +80-20%	5910-974-5697
C13	Tantalum, 47 µF ±20% 20 V	4450-5614	56289	150D4760020R2	
C14	Tantalum, 15 µF ±20% 20 V	4450-5200	56289	150D156X0020B2	5910-855-6335
	DIODES				
CR4	Type 1N91	6081-1009	24446	1N91	5960-677-4865
	INTEGRATED CIRCUITS				
U1	Type MC1469R	5432-1013	04713	MC1469R	
	RESISTORS				
R1	WW, 0.68 Ω ±5% 2 W	6760-8685	75042	CEA, 68 Ω ±5%	
R2	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R3	Comp., 20 kΩ ±5% 1/4 W	6099-3205	75042	BTS, 20 kΩ ±5%	5905-686-3368
R4	Comp., 12 kΩ ±5% 1/4 W	6099-3125	75042	BTS, 12 kΩ ±5%	
R5	Film, 1.40 kΩ ±1% 1/8 W	6250-1140	75042	CEA, 1.40 kΩ ±1%	
R6	Pot. W.W., 100 Ω ±10%	6060-0230	06704	100 Ω ±10%	
R7	Film, 3.09 kΩ ±1% 1/8 W	6250-1309	75042	CEA, 3.09 kΩ ±1%	
R8	Comp., 1.3 kΩ ±5% 1/4 W	6099-2135	75042	BTS, 1.3 kΩ ±5%	5905-686-3119
R9	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
R10	Comp., 12 kΩ ±5% 1/4 W	6099-3125	75042	BTS, 12 kΩ ±5%	
R11	Comp., 2.7 kΩ ±5% 1/4 W	6099-2275	75042	BTS, 2.7 kΩ ±5%	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
	RESISTORS (cont)				
R12	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R13	WW, 1.1 Ω ±5% 2 W	6760-9115	75042	CEA, 1.1 Ω ±5%	
R14	Film, 8.66 kΩ ±1% 1/8 W	6250-1866	75042	CEA, 8.66 kΩ ±1%	5905-755-8130
R15	Pot. W.W., 1 kΩ ±10%	6060-0232	08848	1 kΩ ±10%	
R16	Pot. W.W., 100 Ω ±10%	6060-0230	06704	100 Ω ±10%	
R17	Film, 3.09 kΩ ±1% 1/8 W	6250-1309	75042	CEA, 3.09 kΩ ±1%	
R19	WW, 0.68 Ω ±5% 2 W	6760-8685	75042	CEA, 68 Ω ±5%	
R20	Comp., 20 kΩ ±5% 1/4 W	6099-3205	75042	BTS, 20 kΩ ±5%	5905-686-3368
R22	Film, 13.3 kΩ ±1% 1/8 W	6250-2133	75042	CEA, 13.3 kΩ ±1%	
R23	Pot. W.W., 500 Ω ±10%	6060-0231	06704	500 Ω ±10%	
R24	Film, 8.66 kΩ ±1% 1/8 W	6250-1866	75042	CEA, 8.66 kΩ ±1%	5905-755-8130
R25	Comp., 51 Ω ±5% 1/4 W	6099-0515	75042	BTS, 51 Ω ±5%	
R26	Comp., 2 kΩ ±5% 1/4 W	6099-2205	75042	BTS, 2 kΩ ±5%	5905-686-3370
R27	Comp., 12 kΩ ±5% 1/4 W	6099-3125	75042	BTS, 12 kΩ ±5%	
R28	Comp., 510 Ω ±5% 1/4 W	6099-1515	75042	BTS, 510 Ω ±5%	5905-801-8272
R29	Comp., 220 Ω ±5% 1/4 W	6099-1225	75042	BTS, 220 Ω ±5%	5905-683-2240
R30	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R31 and R32	Comp., 2.7 Ω ±5% 1/4 W	6099-9275	75042	BTS, 2.7 Ω ±5%	
R33	Comp., 1.5 kΩ ±5% 1/4 W	6099-2155	75042	BTS, 1.5 kΩ ±5%	
R34	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R36	Comp., 1.5 kΩ ±5% 1/4 W	6099-2155	75042	BTS, 1.5 kΩ ±5%	
R37	Comp., 27 kΩ ±5% 1/4 W	6099-3275	75042	BTS, 27 kΩ ±5%	5905-683-3838
R38	Comp., 1.5 kΩ ±5% 1/4 W	6099-2155	75042	BTS, 1.5 kΩ ±5%	
R39	Comp., 30 kΩ ±5% 1/4 W	6099-3305	75042	BTS, 30 kΩ ±5%	5905-803-2908
R50 thru R55	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
	TRANSISTORS				
Q1	Type TD-100	8210-1130	56289	TD-100	
Q4	Type 2N3391A	8210-1092	24454	2N3391A	
Q5	Type 2N697	8210-1040	49956	2N697	5961-752-0150
Q7	Type TD-100	8210-1130	56289	TD-100	
Q10 and Q11	Type 2N3391A	8210-1092	24454	2N3391A	
Q13 thru Q15	Type 2N3391A	8210-1092	24454	2N3391A	
	RECTIFIER BOARD VA (P/N 1169-4050)				
	CAPACITORS				
C1	Tantalum, 120 µF ±20% 10 V	4450-5616	56289	150D127X0010R2	
	DIODES				
CR1 thru CR8	Type 1N4140	6081-1014	13327	1N4140	
CR9 thru CR12	Type 1N645	6082-1016	24446	1N645	5961-087-6047
CR13 thru CR16	Type 1N4140	6081-1014	13327	1N4140	
	RESISTORS				
R1	Comp., 4.7 Ω ±5% 1/4 W	75042		BTS, 4.7 Ω ±5%	

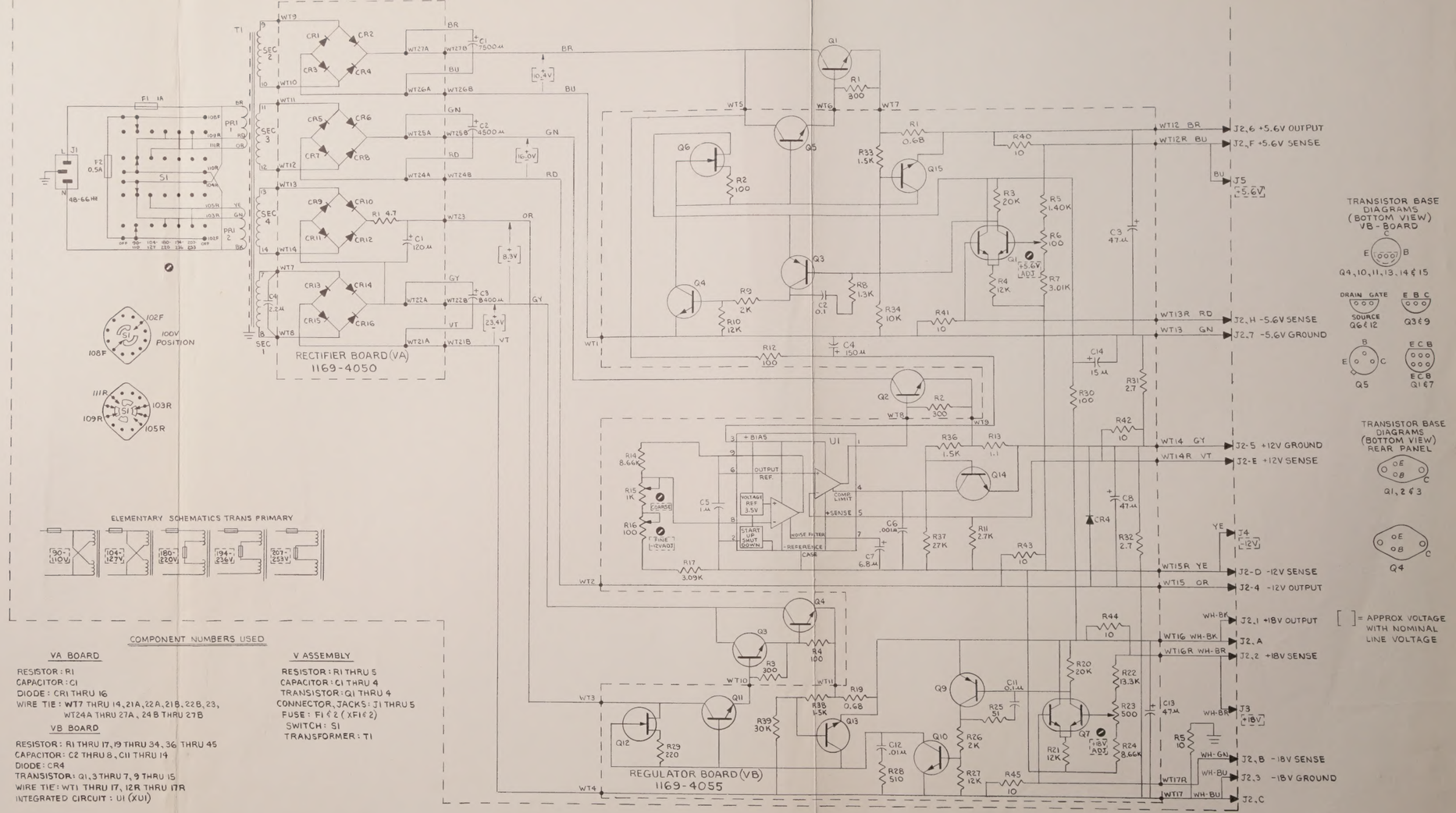


Etched-circuit diagram, Rectifier board — VA (P/N 1169-4050).



Etched-circuit diagram, Regulator board — VB (P/N 1169-4055).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



COMPONENT NUMBERS USED

VA BOARD

RESISTOR: R1
CAPACITOR: C1
DIODE: CR1 THRU 16
WIRE TIE: WT7 THRU 14, 21A, 22A, 21B, 22B, 23, WT24A THRU 27A, 24B THRU 27B

VB BOARD

RESISTOR: R1 THRU 17, 19 THRU 34, 36 THRU 45
CAPACITOR: C2 THRU 8, C11 THRU 14
DIODE: CR4
TRANSISTOR: Q1, 3 THRU 7, 9 THRU 15
WIRE TIE: WT1 THRU 17, 12R THRU 17R
INTEGRATED CIRCUIT: U1 (XU1)

V ASSEMBLY

RESISTOR: R1 THRU 5
CAPACITOR: C1 THRU 4
TRANSISTOR: Q1 THRU 4
CONNECTOR, JACKS: J1 THRU 5
FUSE: F1 & 2 (XF1 & 2)
SWITCH: S1
TRANSFORMER: T1

Figure 6-38. Power supply V. (P/N 1169-4110)

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